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Review

Heat transfer—A review of 2003 literature

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Abstract

The present paper is intended to encompass the English language heat transfer papers published in 2003, including some translations of foreign language papers. This survey, although extensive cannot include every paper; some selection is necessary. Many papers reviewed herein relate to the science of heat transfer, including numerical, analytical and experimental works. Others relate to applications where heat transfer plays a major role not only in man-made devices, but in natural systems as well. The papers are grouped into categories and then into sub-fields within these categories. We restrict ourselves to papers published in reviewed archival journals.

Besides reviewing the journal articles in the body of this paper, we also mention important conferences and meetings on heat transfer and related fields, major awards presented in 2003, and books on heat transfer published during the year.

Keywords: Conduction; Boundary layers; Internal flows; Porous media; Heat transfer; Experimental methods; Natural convection; Rotating flows; Mass transfer; Bio-heat transfer; Melting; Freezing; Boiling; Condensation; Radiative heat transfer; Numerical methods; Transport properties; Heat exchangers; Solar energy; Thermal plasmas

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1. Introduction

This is the first year in which the Heat Transfer Review has not had the active participation of Ernst R.J. Eckert. We wish to recognize Professor Eckert's contributions not only to the heat transfer literature but to founding, maintaining and contributing to the Review for 50 years. His first Heat Transfer Review appeared in the Journal of Industrial and Engineering Chemistry in 1954; this covered the heat transfer literature published in 1953. That first year was a solo effort. Over the years he added faculty active in the Heat Transfer Laboratory at the University of Minnesota as co-authors. Shortly after the start of the International Journal of Heat Mass Transfer in 1960 the Heat Transfer Review moved to this Journal where it has remained ever since. The Review grew from 112 papers in 1954 to the present 1700 papers. Until a dozen years or so ago, Dr. Eckert was the manager and chief organizer of the Review. After he gave up the reins of organization, he continued active participation as an author, even going over some pages of the Review shortly before his death in 2004, a few scant months short of his 100th birthday. Dr. Eckert has been an inspiration to his Review co-authors. We mourn his passing, but are thankful for the many years we could work with him. Because the level of activity and the importance of heat transfer to engineering and science continues to grow, we plan to continue offering the Review, perhaps with a modified format in future editions.

In the current year, considerable effort has been devoted to research in traditional applications such as chemical processing, general manufacturing, energy devices, including general power systems, heat exchangers, and high performance gas turbines. In addition, a significant number of papers address topics that are at the frontiers of both fundamental research and important emerging applications, such as nanoscale structures, microchannel flows, bio-heat transfer, and a number of natural phenomena ranging from upwelling currents in the oceans to heat transport in stellar atmospheres.

The present review is intended to encompass the English language heat transfer papers published in 2003, including some translations of foreign language papers. The survey, although extensive cannot include every paper; some selection is necessary. Many papers reviewed herein relate to the science of heat transfer, including numerical, analytical and experimental works. Others relate to applications where heat transfer plays a major role not only man-made devices, but natural systems as well. The papers are grouped into categories and then into sub-fields within these categories. We restrict ourselves to papers published in reviewed archival journals.

Besides reviewing the journal articles in the body of this paper, we also mention important conferences and meetings on heat transfer and related fields, major awards presented in 2003, and books on heat transfer published during the year.

The 6th ASME–JSME Thermal Engineering Joint Conference (AJTEC2003) was held on March 16–20, 2003 in Honolulu, USA. The 11th International Conference on Nuclear Engineering (ICONE) held in Tokyo, Japan on 20–23 April had sessions on thermo-hydraulics which discussed single and two-phase heat transfer, and core melting accidents. The 5th International Conference on Boiling Heat Transfer was held on 4–8 May at Montego Bay, Jamaica. Topics discussed included experimental methods in boiling, bubble formation and dynamics, and boiling enhancement. The Third Mediterranean Combustion Symposium organized by the International Center for Heat and Mass Transfer (ICHMT) in Marrakech, Morocco on 8–13 June included sessions on flame structure and dynamics, optical diagnostics and radiative heat transfer, and turbulence modeling in reacting flows. The ASME Turbo Expo sponsored by the ASME International Gas Turbine Institute was held in Atlanta, USA on 16–19 June. Sessions covered film cooling, boundary layer transition, and vane internal and external heat transfer. The 36th AIAA Thermophysics conference was held in Orlando, USA on 21–23 June. The 15th Symposium on Thermophysical Properties was organized jointly by NIST and the Heat Transfer Division of the ASME at Golden, USA on 22–27 June. The meeting discussed properties of fuels, phase equilibria, inverse problems in thermophysics, properties of thin films, and photothermal and photoacoustic techniques. The 2nd International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics was held on 23–26 June at Victoria Falls, Zambia. The Annual Meeting of the American Society of Heating, Refrigeration and Airconditioning Equipment (ASHRAE) on 28 June to 2nd July, Kansas City, USA, included sessions on radiant cooling and heating, and on developments in turbine inlet air cooling. The National Heat Transfer conference was held on 21–23 July in Las Vegas, USA. Topics covered included aerospace heat transfer, fire and combustion, bio-heat transfer, and multiphase flows. An International Symposium on Transient Convective Heat and Mass Transfer in Single and Two-Phase Flows was held in Cesme, Turkey on 17–22 August. Sessions covered conjugate heat transfer, instability, and porous media. A symposium on Turbulence, Heat and Mass Transfer was organized by the ICHMT on 17–23 October at Antalya, Turkey. Topics covered included Direct Numerical Simulation and Large Eddy Simulation, closure problems for Reynolds-averaged modeling, and new experimental techniques for turbulent flows. The International Gas Turbine Congress held in Tokyo, Japan, on 2–7 November discussed, among other topics, fuel cells, heat transfer in microturbines, internal cooling and heat transfer in boundary layer transition. The International Mechanical Engineering Congress and Exposition (IMECE) 2003 was held in Washington, DC, USA on 21–23 November. The Heat Transfer Division of the ASME organized sessions on heat transfer in gas turbines, electronic equipment, biotechnology, and environmental heat transfer.

Awards presented in the year 2003 include the following: the Heat Transfer Memorial Awards were presented to Dimos Poulikakos (Science), Michael Yovanovich (Art) and James Welty (General). The 2002 Max Jakob award, given jointly by ASME and AIChE, was conferred on Dr. Yogesh Jaluria for his research in several diverse areas including natural convection heat transfer, thermal processing of materials and computational heat transfer.

Books published on heat transfer in the year 2003 include:

Radiative Heat Transfer, 2nd ed.
Michael Modest
McGraw-Hill, New York

Heat Transfer Handbook
A. Bejan, A.D. Kraus
Wiley–Interscience

Intermediate Heat Transfer
K.-F. Vincent Wong
Marcel Dekker

Advances in Heat Transfer, vol. 37
J.P. Hartnett, Y.I. Cho, G.A. Greene (Eds.)
Academic Press

A Heat Transfer Textbook, 3rd ed.
John Lienhard IV
Phlogiston Press

Computational Fluid Flow and Heat Transfer, 2nd ed.
K. Muralidhar, T. Sundararajan
Alpha Science International

Heat and Fluid Flow in Microscale and Nanoscale Structures
M. Faghri (Ed.)
WIT Press

Cryogenic Heat Transfer
R.F. Barron
Taylor & Francis

Fluidized Bed Combustion
S. Oka, E.J. Anthony
Marcel Dekker

Turbomachinery
R.S. Gorla, A. Khan
Marcel Dekker

Low Temperature and Cryogenic Refrigeration
S. Kakac, H.F. Smirnov, M.R. Avelino (Eds.)
Kluwer Academic Publishers

Numerical Simulation of Reactive Flows in Hot Aquifers
C. Clauser
Springer-Verlag

Computational Methods in Multiphase Flows
A.A. Mammoli, M. Rahman, C.A. Brebbia, M.G. Satish (Eds.)
WIT Press

Thermal Conversion of Solid Fuels
B. Peters, E. Blum, C.A. Brebbia, C.I. Adderley, M. Lamvik (Eds.)
WIT Press

2. Conduction heat transfer

In the category of heat conduction, a wide variety of subtopics appear this year to include: contact conduction/contact heat transfer; microscale/nanoscale heat transport and wave propagation; heat conduction in complex geometries; analytical and numerical methods for the solution of various heat transport mechanisms related to conduction heat transfer; experimental and/or comparative studies; thermal stresses; and miscellaneous studies that deal with a variety of applications in conduction.

Contact conduction and contact resistance. Several studies appear in this subtopic dealing with various aspects of contact conduction and contact resistance. An analytic model accounting for thermal resistance due to multiple moving contact that are circular appears in [1]. Thermal resistance effects due to applications involving workpiece–die interface for forging [2], multi-constrictions contact and simplified models [3], application to particle ladden polymeric interface materials [4], consideration of conforming rough surfaces with grease-filled interstitial gaps [5] are some of the studies which appeared in this year. Other aspects include the significance of surface contact effects for multiphase heat transfer [6], heat exchange coefficient function in thermoelastic contact [7], influence of flatness and waviness of rough surfaces [8], measurements of contact parameters [9] for spot welding. review of thermal conductance models for joints [10], and studies with numerical analysis of heat flow [11], and effects of overloading and unloading [12].

Microscale/nanoscale heat transport and wave propagation. This subject matter continues to receive widespread attention and involves analytic models, numerical simulations and experimental aspects. Studies involving the notion of hyperbolic heat conduction and relevant effects such as overshooting phenomena, thermal losses, reverse time modeling, spectral methods for numerical studies appear in [13–16]. Those dealing with wave propagation aspects and short pulse laser heating effects appear in

[17–25]. Additional papers dealing with studies of comparative models [26], heat transfer in multilayer structure [27], bilayer composite sphere due to sudden temperature change [28], and phonon heat conduction in micro- and nano-core-shell structure [29] appear in this subcategory.

Heat conduction in complex geometries. Heat transfer aspects due to conduction in complex geometries such as transient thermal load in multilayer structure [30], steady-state conduction in multilayer bodies [31], annular fins [32], effect of gap size and spacing [33], composite slabs [34], and optimization of transverse thermal conductivities [35] in unidirectional composites appear in this subcategory.

Analytical and numerical methods. Analytic models and close form solutions for unsteady heat conduction in two-dimensional slabs [36], inverse solution of one-dimensional and two-dimensional heat conduction [37,38] appear in this subcategory. Those dealing with simulations and numerical techniques using any one of a number of approaches, such as transfer functions, finite elements, meshless methods, genetic algorithms, etc., appear in [39–47].

Experimental and/or comparative studies. The studies in this subcategory include an experimental thermal contact conductance of a bead-blasted SS 304 at light loads [48], bi-metallic heat switch for space applications [49], determination of neurocontrol of a heat conduction systems [50], measurements of thermal contact conductance [51], and thermal contact resistance of aluminum honeycombs [52].

Thermal stresses. Thermal stresses induced due to effect of microscopic heat conduction model [53], and thermo-elastic waves in a helix with parabolic and hyperbolic heat conduction [54] appear in this review year.

Miscellaneous applications. A wide variety of studies dealing with heat conduction for various problems and applications appear in [55–62].

3. Boundary layers and external flows

Papers on boundary layers and external flows for 2003 have been categorized as follows: flows influenced externally, flows with special geometric effects, compressible and high-speed flows, analysis and modeling techniques, unsteady flow effects, flows with film and interfacial effects, flows with special fluid types or property effects and flows with combustion and other reactions.

External effects. Experimental results which document the effects of streamline curvature and streamwise acceleration are presented [63]. The effects on laminar, transitional and turbulent boundary layer flows with curvature and acceleration are documented. Variations of as large as 35% are recorded. Documentation of the effects of turbulence in the freestream on boundary layer heat transfer continues to be an active topic. An experimental investigation of grid-generated turbulence was presented [64]. Heat transfer is enhanced by velocity fluctuations attributed to changes in the boundary layer velocity profile. Experiments are conducted to study the effects of turbulence length scale on boundary layer heat transfer [65]. Various ratios of freestream length scale to boundary layer momentum thickness were created. Increases of Stanton number of as large as 46% were recorded. A study by the same authors analyzes and correlates these results, deriving a new two-region model for Stanton number [66]. The effects of freestream turbulence level on heat transfer to an endwall of a gas turbine cascade are evaluated [67]. Turbulence levels from 0.7% to 14% are studied. A paper from the same lab documents the characteristics of turbulence as generated by gas turbine combustors of different types [68]. The combustors ranges from a catalytic type to a low-NO$_x$ type. The effects of a single vortex on boundary layer heat transfer are analyzed using the von Karman integral equation [69]. Momentum, heat transfer and the analogy factor are described by phenomenological decomposition. Chaotic advection, or Lagrangian turbulence, and its enhancement of laminar boundary layer heat transfer are studied [70]. The fluid particle trajectories that are chaotic due to boundary displacement or change in geometry are considered in explaining the enhancement. The effects of surface heating and cooling on airfoil aerodynamic efficiency are documented [71]. Lift is increased by upper surface cooling and lower surface heating. The effects of surface suction and blowing on a boundary layer are analyzed [72]. Parameters to the problem are the Prandtl number and the accelerated flow wedge angle. The effects of surface vibration of a channel wall on wall heat transfer rates are analyzed with perturbation methods [73]. Acoustic streaming is established and a system of steady vortices which is responsible for heat transfer enhancement develops in the gap. The effects of an imposed magnetic field on a micropolar fluid are computed [74]. Effects of various parameters on velocity and temperature fields and heat transfer coefficients and skin friction coefficients are evaluated.

Geometric effects. Direct Numerical Simulation (DNS) of a stagnation region flow is presented [75]. Noted is the significant effect of large-scale eddies on enhancement of wall heat transfer. A three-dimensional DNS of turbulent separated flow over a blunt flat plate [76] shows that the reattached flow region exhibits a hairpin-like structure. Cases with different plate thicknesses and Reynolds numbers show that the reattachment length is about five plate thickness and that the Nusselt number is strongly dependent upon Reynolds number. An extension of the Spalart–Allmaras turbulence model for surface roughness is presented [77]. Difficulties in modeling with the equivalent sand grain roughness are noted. The effect of a droplet of one liquid on the turbulent flow of another liquid is visualized [78]. Low temperature fluid is pushed into the buffer region of the boundary layer by the wallward flow along the cap of the droplet. The outward flow in the droplet wake causes lift up of hot fluid adjacent to the wall. The two flows enhance heat transfer. A similarity solution is applied to flow with a streamwise pressure gradient over a stretching surface [79]. The analysis shows the conditions under which unique solutions exist. A numerical study shows the effects of a corner fillet and of flow inlet swirl on heat transfer and aerodynamic losses in a gas turbine cascade [80]. The study shows the effects of the interactions of secondary flows with the main flow. Heat transfer from turbine blade tips is experimentally investigated [81]. Shown is a comparison between flat tips and squealer tips. From the same lab are studies of the effects of turbulence level and chord Reynolds number [82] and relative motion of the shroud [83] on tip heat transfer. Liquid crystal thermometry is applied to a tip heat transfer study [84]. Heat transfer coefficients on the tip are higher than those on the shroud or blade surface. Measurements from the same lab show heat transfer rates for plane tips compared to rates for squealer tips [85]. The squealer tips provide lower heat transfer coefficients on the tip and near tip regions.

Compressibility and high-speed flow effects. Large Eddy Simulation (LES) is applied to transonic turbulent flow over a bump [86]. A perceived poor modeling performance for this type of flow may have been due to the rapid rise and decay of turbulence levels in the separated shear layer immediately under the shock wave. Skin friction measurements are reported for a hypersonic boundary layer [87]. A new skin friction gauge is employed. Prediction with the Spalding and Chi method for skin friction and a Reynolds analogy factor near unity are shown to give suitable heat transfer rates to the wall. The compressible flow equations are solved for a boundary layer [88]. It is shown that skin friction coefficients are bracketed by the von Karman compressible fluid formula and the von Karman incompressible fluid formula. Shock shapes in hypersonic air flow over a sharp cone are computed [89]. The two-temperature model matches measured results for flow without chemical reaction or vibrational excitations. However, when vibrational excitation appears, the shock layer thickness is underestimated by the two-temperature model. A solution of the Boltzmann equation is proposed for cases in which the distribution function depends on both slow and fast time scales and coordinate scales [90]. Additional terms accounting for relaxation effects are included. An improved model for shock tube analysis is proposed [91]. The improvement comes from a modern friction model. Numerical simulations of laminar shock/shock interactions are studied [92]. Issues related to boundary conditions, grid convergence and time unsteadiness of the computations are addressed. The effects of vibrational non-equilibrium in hypersonic double-cone experiments are computed [93]. The simulations show that vibrational modes of the nitrogen gas freeze near the nozzle throat resulting in elevated vibrational temperatures in the test. The interactions of a moving shock wave with a two-phase (gas and particles) flow are predicted [94]. Applications of the results are explosions at coal mines or grain elevators. Simulations of afterbody heating of a ballistic reentry to earth are presented [95]. Mechanisms which explain for the conservative results of the simulations for afterbody heating are discussed.

Analysis and modeling. An improvement to the analysis of katabatic flows is proposed [96]. The new model is proposed for estimations of surface flux to inclined stable meteorological boundary layers. A nonlinear near-wall turbulence model is proposed [97]. It includes an improved explicit heat flux model which captures the effects of flow deformations. Numerical experiments using DNS and Lagrangian scalar tracking (LST) are employed to analyze the dispersion of a passive contaminant from a wall by turbulence [98]. Turbulent diffusivity and turbulent Prandtl number a the plume that results from a line source are calculated. A stochastic model for dispersion and deposition of particles in a turbulent field is explored [99]. Physical understanding of the concentration distribution and rate of deposition is of particular interest. A prediction of turbulent heat transfer with surface blowing with a nonlinear algebraic heat flux model is explored [100]. The reduction of wall shear stress and the change in wall heat flux agree with data. Modeling of transition from laminar to turbulent boundary layer flow is tested with two intermittency models [101]. Results are compared with measurements in a linear turbine cascade. Spreading angles of turbulent wedges induced by surface roughness in a heated boundary layer are visualized [102]. The results suggest that the spanwise growth of the turbulent region is smaller in a thermal boundary layer than in its momentum counterpart. This may explain the inconsistency of transition zone lengths reported in the literature. The use of point source solutions to compute cooling of electronic components on a conducting plate is discussed [103]. New correlations are presented. A two-flux model is applied for the analysis combined radiative transfer and forced convection in a laminar boundary layer on a flat plate [104]. The "method of columns" is applied to transform the resulting equation into an ordinary differential equation system for solution.

Unsteady effects. An experimental and numerical study is conducted on the influence of incoming wakes, including their calming effects, on transitional boundary layers on surfaces of turbine airfoils [105]. Results are used to describe the pressure loss coefficient and heat transfer around the airfoil surface. Numerical evaluation of heat transfer over an unsteady stretching surface with internal heat generation is presented [106]. Results are presented for various values of the unsteadiness parameter, the Prandtl number and the heat source parameter. Numerical results are presented for mixed radiative and convection flow of a micropolar fluid past a moving, semi-infinite, porous plate [107]. Comparisons are made with a similar flow of a Newtonian fluid. An approximation is used to describe radiative heat transfer in the limit of optically thick fluids.

Films and interfacial effects. Experiments are made to study vapor absorption by LiBr aqueous solutions in vertical smooth tubes [108]. Breakdown of the liquid film into rivulets is shown to lead to deterioration of heat and mass transfer at low film Reynolds numbers. The effects of a microscale surface treatment on heat and mass transfer in a falling film $H_2O/LiBr$ absorber is experimentally evaluated [109]. A new method of wettability measurement is applied. Hydrodynamics and heat transfer in a bubbly flow within a turbulent boundary are modeled [110]. A good comparison to experimental data is noted. Interfacial transport outside of spheroidal bubbles or solids is numerically evaluated [111]. Drag coefficients and local and mean Sherwood and Nusselt numbers are computed. The effects of surfactants on passive scalar transport in a fully developed turbulent flow are computed [112]. As surface elasticity is increased, turbulent fluctuations are damped and mean surface temperature is changed. The effects of thermocapillary forces in a liquid film on an unsteady stretching surface are computed [113]. The thermocapillary forces drag the liquid film in the same direction as the stretching sheet. Nusselt numbers at the sheet increase with thermocapillary strength for fluids of Prandtl number less than 10. Heat transfer rates between air and a falling laminar film on an isothermal inclined surface are computed [114]. An apparent viscosity for the ostwaldian liquid is defined. DNS is applied to compute turbulent heat transfer across a mobile, sheared, gas–liquid interface [115]. A new scaling law for a normalized heat transfer coefficient is derived. Results of numerical simulations of an oscillatory falling liquid film are applied to investigate the interfacial wave behavior and heat transfer [116]. Heat transfer is enhanced by small vortices between the solitary and capillary waves in addition to enhancement from flow recirculation in the solitary wave.

Effects of fluid type or fluid properties. An analysis is made for steady flow of a non-Newtonian fluid past an infinite, porous, flat plate with suction or blowing [117]. It is shown that a steady solution for velocity distribution exists only for a pseudoplastic fluid for which the power law index is within a certain range. Both skin friction and heat flux at the plate are shown to be independent of the power law index. Heat transfer in a power law fluid film over an unsteady stretching sheet is numerically evaluated [118]. For small Prandtl numbers, the surface heat flux increases with a decrease in the power law index. Particle deposition from two-dimensional, turbulent, gas flows are predicted [119]. Thermophoresis effects in non-isothermal flows are represented. Non-isothermal turbulent flows laden with particles which exchange heat with the surrounding fluid are simulated [120]. Statistical properties of the particle phase over a Lagrangian trajectory are computed from the velocities and temperatures of a large number of particles along the trajectory. Temperature statistics in particle-laden, turbulent homogeneous shear flows are computed [121]. Transport mechanisms are discussed by examining the budgets of the temperature variances and turbulent heat fluxes for both phases. The physical situation of two-phase, non-isothermal, turbulent fluid flows laden with non-evaporating spherical particles is analyzed using a closed kinetic equation [122]. Results are compared with DNS results. The effects of shear work at solid boundaries in small-scale gaseous flows where slip is present are discussed [123]. The effects of the shear work on convective heat transfer are illustrated with a particular solution. The theory for steady-state thermodynamics of shearing linear viscoelastic fluids is presented [124]. The viscoelastic work is divided into elastic (reversible) and viscous (irreversible) parts.

Flows with reactions. A numerical study of the effects of methane combustion on heat and mass transfer in a boundary layer is presented [125]. Combustion leads to more intense displacement of the flow away from the wall which decreases heat and diffusion fluxes. This may lead to laminarization or delay of transition. Solutions of the Navier–Stokes equations are obtained to determine burning rate Nusselt numbers for a flat plate of reacting material (PMMA) [126]. Rates computed with steady-state pyrolysis compare well with measured values, except near the leading edge where the heat feedback is high and the steady-state pyrolysis assumption cannot be made. The effects of stretch on flame wall interaction are experimentally evaluated [127]. Evolution of stretch rate versus time shows that a quenching stretch rate can be reached and locally the flame is extinguished for a near-stoichiometric reaction. The effects of vortex restructuring on heat transfer in an inverted flame are evaluated [128]. The vortex structure increases the critical Reynolds number at which the flow becomes turbulent. Computational results are presented for gas and particle flows in flame spraying [129]. The particle velocities and temperatures predicted by the simulations compared well with experimental results. Experimental results are presented for gas absorption into a "string-of-beads" liquid flow with chemical reaction in carbon dioxide separation [130]. The string of beads flow is a distinct on-wire, liquid flow pattern consisting of annular thin liquid films sheathing a wire and teardrop-shaped liquid beads alternately aligned on the wire at regular intervals. Diffusion and kinetic effects in spherical expanding flows of argon–helium mixtures in the supersonic regime, but at low Knudsen numbers, are studied using a direct simulation Monte Carlo technique [131]. In the supersonic region, "freezing" of the parallel species temperature has been found in all cases. This freezing comes first for the heavier molecule of argon.

4. Channel flows

Straight-walled ducts. Channels having at least one primarily straight wall begin this section of the review. Experimental data were presented for the heat transfer associated with the cooling of gaseous carbon dioxide in a horizontal tube [132]. Convection in a horizontal rectangular duct was examined analytically and numerically considering variable fluid properties [133]. A full Reynolds stress model was used to predict turbulent heat fluxes; various models were compared [134]. A two-equation turbulence model was employed to model turbulent heat transfer in ducts [135]. The validity of local thermal equilibrium was studied numerically in conjugated forced-convection channel flow [136]. Fully developed mixed convection is investigated analytically in a vertical channel [137]. Low Reynolds number mixed convection was also studied in vertical tubes with uniform wall heat flux [138]. Conjugated heat transfer in thick walled pipes was treated by a finite difference approach applying convective boundary conditions [139]. The turbulent flow of gases with varying physical properties was computed incorporating the tangential stress profile [140]. Property variations were also studied using large-eddy simulation with constant heat flux [141]. Turbulent planar Couette flow was investigated at low Reynolds numbers using DNS [142]. The choked (continuum and slip) gas flow through narrow channels was studied experimentally [143]. The lattice Boltzmann method was used to study forced convective heat transfer in plane channels [144]. The role of an electric field on heat transfer enhancement was investigated numerically [145]. A first and second law analysis was conducted to examine mixed convection in a channel flow with a transverse hydromagnetic effect [146]. Constant heat flux conditions were studied in laminar flow of a latent functionally thermal fluid [147]. Fluid flow and convective heat transfer were studied for a fluid having suspended nanoparticles [148]. Turbulent mixed convection was investigated experimentally using air flow over an inclined flat channel [149]. Wall heat sources were studied using a Lagrangian stochastic simulation [150]. The second law characteristics of laminar circular and planar channel flows were studied [151]. The laminar forced convective heat transfer was examined numerically near critical conditions [152]. The extended Graetz problem was considered by laminar Hartmann's flow with uniform wall heat flux [153]; the Graetz problem was also examined with piecewise constant wall heat flux inside concentric annuli [154]. The thermal entrance region of plane Poiseuille flow heated uniformly from below was studied; the onset of convective instability was also examined [155]. A new entropy generation mechanism was used for thermal optimization of channel flows with discrete heating sections [156]. The effect of Froude number on surface waves and heat transfer was studied in inclined open channel flow [157]. A direct numerical simulation was performed to study turbulent convection in a concentric annuli [158].

Microchannel heat transfer. Microfabrication techniques now allow for a myriad of geometrical possibilities. In this section, studies conducted to understand the heat transfer characteristics in these small channels will be summarized. A review of the technology and development of the thermal aspects of microchannels in applied microelectronics and other high heat flux applications was provided [159]. The two-phase flow and heat transfer behavior was studied in parallel microchannels [160]. The lattice Boltzmann model was used to investigate electrokinetic microchannel flow [161]. Constant wall heat flux was imposed on an electroosmotically generated channel flow [162]; pressure driven effects were also considered [163]. An experimental study was conducted to understand the heat transfer characteristics associated with falling film absorption on microscale hatched tubes [164]; the thin-film region of a microchannel was also studied [165]. The impact of various surface conditions was examined experimentally in silicon microchannels [166]. Computational methods were used to understand the role of compressibility on gas flows in microchannels [167]; a numerical approach was also used to study the laminar flow and heat transfer of gas in rectangular microchannels with constant wall heat flux [168]. Scale effects were reviewed and their physical significance discussed in single-phase microchannel flow [169,170]. Monte Carlo, Navier–Stokes and Burnett equations were used to predict the flow and heat transfer in micro-Couette flow [171]; the Monte Carlo method was also used to understand the non-ideal gas flow in micro- and nanochannels [172] and the effect of surface roughness on nitrogen flow [173]. Gas flows were also modeled through microchannels and nanopores [174]. Electrokinetic effects were considered in a microchannel with a T-junction [175]. In perhaps the most complex geometry seen, a micromixer in a twisted microchannel was simulated [176]. Finally, a theoretical analysis was undertaken to understand the heat transfer in a microchannel of electrokinetic flow under asymmetric boundary conditions [177].

Irregular geometries. In this subsection we summarize papers in the literature covering a variety of irregular geometries, though generally confined to channels. One paper proposed a strategy for designing convective flows with maximal heat transfer rates using a body fitting approach [178]. A numerical study was conducted to understand the heat transfer characteristics for flow through parallel boards with heat generating blocks [179]. Heat transfer enhancement was studied by employing a convex-patterned surface [180]. Oval tubes and vortex generators were used in a channel to improve their thermal performance [181]. Transient temperature measurements were made to evaluate mixed convection longitudinal vortex flow driven by a heated circular plate in a duct [182]. Strip-type inserts were placed in small tubes for heat transfer enhancement [183], as well as a built-in heated square cylinder in a channel [184]. An oblique discrete rib mounted in a square duct was analyzed numerically [185]. The heat transfer between blockages with holes was investigated [186]. A spherical dimple was used to create vortex flow in a narrow turbulent channel flow [187] and study the effect of dimple depth [188]. A numerical approach was taken to understand the conjugate heat transfer associated with a concentric annuli with a moving inner rod [189]. The effect of mixing vane shape on heat transfer was examined in a subchannel of a fuel assembly [190]. The heat transfer in an air duct with an inclined heating surface was investigated experimentally [191]. Thermal-fluid characteristics were studied in fully developed circular tubes of turbulent flow with six different surface concavities [192]. A number of studies were conducted to understand the fluid flow and heat transfer inside periodically varying or wavy tubes [193–197].

Finned and profiled ducts. Fins, profiling, protuberances, tape-elements and general surface roughening are used to enhance heat transfer in ducts. The application of angled ribbed turbulators was studied using infrared thermography [198]. Experimental results were presented for a dimpled surface positioned in a channel [199]. Experiments were conducted to study the heat transfer from a tube with elliptic pin fins [200]; pin fins were also used in a channel to examine variable property Nusselt numbers [201]. Liquid crystal heat transfer measurements were employed to understand the heat transfer behavior in a rectangular channel with solid and slit ribs [202]. Angled crossed-rib turbulators were used for heat transfer augmentation in a channel; data and flow visualization results were presented [203]. Winglets were introduced into a rectangular duct to increase heat transfer rates; the winglets were found to perform better than traditional transverse disturbances [204]. Surface-mounted cross-ribs were positioned in a turbulent channel flow for air cooling [205]. A numerical approach was taken to understand the behavior of periodically located vortex generators in a laminar and transitional plane channel flow [206]. A novel method is presented to predict the heat transfer inside tubes with twisted tape inserts [207]; numerical predictions of laminar and turbulent heat transfer in a square duct with twisted tape inserts was also found in the literature [208]. Various turbulence models were used to predict the heat transfer from an array of heated modules [209]. The impact of 45-degree rib turbulators on the Nusselt number for variable properties was studied; temperature ratio effects were also investigated [210]. The role of roughness in small diameter tubes was examined at low Reynolds numbers [211]. A combined experimental and computational study was undertaken to understand the heat transfer in straight cooling passages with inclined ribs on opposite walls [212]. Strip-type inserts were used in a horizontal circular tube for heat transfer augmentation [213]. The combination of ribbed tubes and a wire coil insert was considered in an experimental investigation; Reynolds numbers from 3000 to 30,000 were examined [214,215]. An experimental study looked at the impact of varying numbers of ribbed walls in rectangular channels [216]. A corrugated inner tube forming an annulus was studied experimentally in water at Reynolds numbers between 1700 and 13,000 [217]. Local Nusselt numbers were provided in a study of heat transfer in rectangular channels with 45-degree crossed-rib turbulators [218]. The effect of the secondary flow created by ribs on heat transfer was examined experimentally [219]. A numerical study was conducted to evaluate the role of V-shaped ribs in square ducts [220,221].

Ducts with periodic and unsteady motion. Transient motion, unsteady, and periodic duct flows/thermal effects will be considered next; flows with strong secondary and/or swirling motion are also contained in this subsection. Oscillatory flow in open-ended tubes was studied; the effective thermal conductivity was presented [221]. Periodically varying thermal loading was studied in thin films using flexible complex seals [222]. The periodic resonance condition in a Rijke tube was investigated; the nonlinearity of the heat transfer process on the limit-cycle behavior was studied [223]. A numerical study considered the reciprocating forced convection in two-dimensional channels [224]. The pulsatile turbulent flow in a sudden expansion was addressed in a numerical investigation; the impact of pulsation on the Nusselt number was significant [225]. Nusselt–Graetz number correlations were produced for heat transfer in channels having sinusoidally varying cross-sections [226]. Oscillating vortex generators were used for heat transfer augmentation in channel flow; a Lagrangian–Eulerian kinematic method was adopted [227]. Oscillations were produced in a heated channel using a cylinder; numerical results showed substantial increases in the heat transfer rate [228]. Secondary motion can be readily established in channels through bends, elbows, or coiling; several studies looked at the heat transfer behavior accompanying this motion. Thermal radiation and turbulent convection were considered in a curved pipe with uniform wall temperature [229]. The unsteady effects created by a sharp 180-degree bend were studied numerically [230]. A non-isotropic algebraic stress turbulence model was used to examine the thermal-fluid behavior of a curved open channel [231]. The heat transfer associated with turbulent flow in a U-bend was investigated using the generalized gradient diffusion hypothesis [232]. Numerical simulation was used to understand the convective heat transfer in externally heated curved rectangular ducts [233]. Swirl was directly imposed in a few studies of convective heat transfer [234–236].

Multiphase and non-Newtonian flows in channels. A viscoplastic material was used in the thermal entrance region of a concentric annulus; the equations were solved via a finite volume method [237]. A power-law fluid was introduced into a parallel plate channel with one moving plate; laminar heat transfer was documented [238]. A power-law fluid was also studied in the thermal entrance region of a circular pipe using the integral boundary layer technique [239]. The unsteady motion of a Green–Rivlin fluid was investigated in straight tubes of arbitrary cross-section [240]. Asymptotic Nusselt numbers were evaluated for various axial distributions of wall heat flux for Bingham plastics in circular ducts [241]. A finite element method was used to study the behavior of a power-law fluid in a right triangular duct [242]. The Graetz problem was reexamined for a viscoelastic fluid obeying the Phan–Thien and Tanner constitutive equations [243]. Experiments were conducted to evaluate the temperature rise in a non-Newtonian fluid in oscillatory pipe flow [244]. A combined numerical and experimental study considered the Joule heating and heat transfer in poly(dimethylsiloxane) microfluidic systems [245].

5. Separated flows

This section deals with papers addressing heat transfer characteristics in flows experiencing separation, either by rapid changes in geometry or strong adverse pressure gradient. This section also includes the thermal behavior of flow past bluff objects, jets, and reattachment. The mixed convection associated with flow past a heated blunt obstacle was examined numerically [246]. A numerical simulation was also employed to understand the laminar flow and heat transfer in tube bundles [247]. Local heat transfer measurements were made around a wall-mounted cube held at 45° to the approaching turbulent flow [248]. The separation dynamics for flow over a circular cylinder were studied; focus was placed on how heating the cylinder impacted the separation process [249]. The heat transfer rate was found to depend strongly on viscous dissipation for the non-uniform slot injection into water boundary layers over cylinders and spheres [250]. The role of free stream turbulence on the heat transfer in separated flows was studied experimentally [251]. A numerical study examined the laminar flow and heat transfer past square bars arranged side by side [252]. Computational methods were used to investigate the conjugate heat transfer from small cylinders, similar to hot wires, when located near walls [253]; very small heated cylinders were also studied to understand vortex dynamics and thermal transport [254]. Mixed convection was studied as it develops behind a vertical isothermal cylinder located in water at low temperatures [255]. Heat transfer was measured downstream of a backward-facing step in very high-speed flow (superorbital flow) [256]. The laminar flow and heat transfer was studied for accelerated flow conditions past an elliptic cylinder [257]. The impact of forced injection from a laminar boundary layer on a blunt body was examined [258]. The heat transfer of flow past a cylinder with permeable versus solid fins was investigated; various numbers of fins and fin heights were considered [259]. A slot jet was used to cool a heated circular cylinder; mean and local Nusselt numbers were measured versus Reynolds number [260]. Heat and mass transfer measurements were measured and compared for flow past a rectangular cylinder [261]. A finite difference method was employed to understand the unsteady flow and heat transfer from a vertical cylinder having temperature oscillations [262]. Heat transfer characteristics were computed for an incompressible power-law fluid; both shear thickening and shear thinning fluids were considered [263]; a power-law fluid was also used in a numerical study of flow past a square cylinder in a plane channel [264]. The role of an imposed magnetic field was analyzed on a moving vertical cylinder with constant heat flux [265]. Nusselt numbers were obtained for gas flow over a wire surface when a powerful acoustic field was imposed on the flow [266]. Total temperature measurements were used to quantify the energy transport caused by vortex motion in a free jet in a process called energy separation [267]. Heat transfer coefficients were obtained for conditions associated with airfoil icing [268]. The heat transfer characteristics during separation and reattachment were studied in turbine blade cascade configurations [269]. Unsteady separation and reattachment and the corresponding heat transfer were also investigated for flow over a rectangular plate experiencing an oscillating inlet velocity [270].

6. Heat transfer in porous media

Several reviews and re-evaluations of modeling paradigms for saturated and unsaturated porous media have appeared during the past year. A unified streamline and heat and mass line method for the visualization of two-dimensional heat and mass transfer in anisotropic media shows promise for convective diffusion problems of the type encountered in porous media [271]. The method of asymptotes was applied to the Rayleigh–Bénard problem to demonstrate the location of a state at which global resistance of heat transport is minimized [272]. A comprehensive review nonlinear convection showed that not all predictions are experimentally validated [273].

Representation of a random porous medium with a universal dimension is shown to lead to significant errors in calculating total drag and heat transfer [274], and basic terminology describing Darcy's law has been critically reviewed [275]. The permeability of unsaturated media has been determined via a fractal model of the pore structure [276].

Two-equation modeling of the heat conduction problem is the focus of numerical work that compares results to a numerical solution at the microscopic level [277]. A simplification of the mass balance equation is shown to reduce computational cost for numerical prediction of multi-dimensional convective heat and mass transfer [278]. Modeling of heat transfer in unsaturated flow in dual scale fibrous media where fiber bundles and flow channels coexist shows a marked deviation from that predicted by single scale modeling [279]. The mass transfer jump at the interface between a porous medium and fluid has been reformulated based on a non-local boundary region form of the volume averaged mass transfer equation [280].

6.1. Property determination

Determining the effective thermal conductivity and total diffusivity of saturated and unsaturated porous media are the focus to goodly number of studies, which underlies the centrality of the property in both theoretical work and interpretation of experimental data. Temperature distributions in heated packed beds of spheres are used with solution of the inverse problem for transient heat transfer, and with a step change in the boundary heat flux, the effective conductivity may reach a value several times higher than at steady state [281]. Linear packing theory, a unit cell model, and particle size distribution functions are used to determine the effective conductivity for beds of polydispered particles, with good agreement with measurements [282]. A related study assumes non-equilibrium between the phases, applied local volume averaging, and a characteristic temperature distribution to yield a definition of an effective and coupled thermal conductivity tensor [283].

Bounds on effective conductivity of paced beds of rough spheres have been evaluated numerically using a unit cell structure and then compared with experiments [284]. Local effective diffusivity of a hydrophilic fibrous medium has been determined via a network model for species diffusion as a function of local porosity and local saturation [285]. Thermal dispersion associated with non-isothermal filling of a fibrous medium is modeled with a series solution for dispersion, which was verified by comparing model results with the steady-state analytical solution [286].

6.2. Effective conductivity in combined radiation and conduction in high porosity, high temperature

Fibrous insulation was measured from 300 to 1300 K for a range of pressures and densities, and good agreement is obtained with a numerical model employing a two flux approximation and anisotropic scattering [287]. Combined mode conductivity is used with Fricke's equation to determine the radiative thermal conductivity at 450 K in non-woven fabric materials [288]. The effective radiative conductivity for packed beds is developed in the form of a correlation between the wall Nusselt number and effective radial thermal conductivity [289].

The effective conductivity of porous ceramics in which gas emission takes place has been quantified via experiments and a pore-scale mechanism is proposed [290]. Measurements of the effective bulk conductivity of a recently developed porous carbon foam have been reported [291].

6.3. External flow and heat transfer

The linear instability of vortex flow in mixed convection next to a flat surface in uniform and variable permeability media has been characterized via a compact non-dimensional group involving the local Rayleigh and Peclet numbers [292]. Vortex instability of natural convection over a horizontal flat place in a high porosity medium is analyzed with form drag and viscous diffusion effects considered [293]. Gravity jitter on free convection on a vertical plate is shown to have its greatest effect near the leading edge [294].

The stress jump interface condition for flow over a porous layer has been examined numerically including the influence of medium properties and the Forchheimer correction term [295]. Numerical and experimental work for flow over a porous cylindrical annulus leads to scaling rules in terms of key dynamical and geometrical parameters [296]. Experiments have been carried out for convection from aluminum-foam heat sinks in forced convection cross-flow to determine overall thermal performance [297].

Similarity solutions have been developed for a buoyant plume above a line source show how anisotropy in the medium can affect flow and heat transfer [298]. Free convection on a horizontal surface via similarity is predicted for Newtonian and non-Newtonian fluids [299], and an explicit solution is also developed [300]. Viscous dissipation effects for power-law fluids are also treated via similarity for both the horizontal and vertical plate [301]. Similarity and approximate solutions are reported for free, mixed and forced convection on a horizontal surface with a range of temperature and wall blowing parameters [302,303]. The two-equation approach has been applied to the Cheng–Minkowycz problem, and it is shown how the absence of thermal equilibrium can modify leading edge flow and heat transfer [304]. The vertical plate problem is also analyzed for an embedding medium with heat sources and nonlinear density temperature variation [305].

Numerical and asymptotic techniques have identified the thermally long, intermediate, and short length limits for conjugate heat transfer from a vertical strip in an unbounded medium [306]. Conjugate free convection from a vertical fin has been analyzed for the effects of two-dimensionality and the shortcomings of the classical insulated tip boundary condition [307]. Similarity solutions for flow of a micropolar fluid past a flat surface with variable temperature were developed in terms of microrotation parameter, inertia coefficient, permeability and coupling parameter [308].

Mixed convection with surface mass flux and variable heat flux on a vertical plate and cylinder in non-Darcy media has been analyzed to predict a variety of parameter interactions that determine trends in Nusselt numbers and temperature distributions [106,309].

Forced convection over a plate with prescribed temperature is solved with and altered asymptotic boundary condition far away form the place and formally shown to transform into a transient conduction problem [302]. Forced convection from a heated cylinder at high Peclet number has been analyzed numerically via a two-equation formulation, and it is found that the surface heat transfer rate for the fluid is always greater than that for the matrix [310].

Condensation in forced convection to produce porous coatings in a thin porous layer on a vertical surface has been analyzed in terms of the Darcy–Brinkman–Forchheimer formulation in the porous medium and the standard boundary layer approximations in the condensate [311]. Film condensation on a finite flat surface embedded in a porous medium has been predicted via a boundary layer formulation when the vapor phase is dry and saturated [312].

6.4. Packed beds

Entropy generation in MHD mixed convection with radiative interaction in porous channel flow is solved analytically for the optically thin gas approximation [313]. Magnetic fluid jets in saturated media are investigated using Taylor's theory, and a multi-scale solution reveals parameters for stable and unstable flow [314]. Radiative heat transfer in coarse fibrous media, modeled as an array of mono-dispersed random cylinders, produces upper and lower bounds for existing transport data in terms of cylinder geometry and radiative properties [315].

Viscosity variations and permeability are shown analytically to exert a strongly coupled effect on forced convection in heterogeneous fixed beds [316]. A three-dimensional numerical solution for transport in a fixed bed at the large particle limit reveals a diffusion dominated wall sub-layer that is one-fourth of the particle diameter and a second sub-layer on all particles in contact with the wall [317]. A parallel study using a commercial CFD code predicts heat and mass transfer coefficients in good agreement with existing data [318]. Measured wall-to-fluid mass transfer coefficients for low flow and a large tube-to-particle diameter ratio are shown to approach a non-zero limit as Reynolds number approaches zero [319]. Mass transfer in the free convection limit for cylinders embedded in a fixed bed based on measurement provided additional design guidance for low flow applications with tube banks [320]. Turbulent flow and heat transfer in a channel with a staggered array of porous baffles serves as a transition case for the packed bed and channel flow with solid baffles [321].

A single heat and mass transfer correlation for trickle beds in terms of a Peclet number has been developed from existing data and validated [322]. High heat flux applications, such as occur in porous metal walls of fusion reactors, have also begun to receive theoretical attention with the aim being an optimization of the heat transfer rate [323]. A related study deals with the transient thermal response of a moving porous bed with gas through flow [324].

Measurements of velocity and shear stress over and within a fixed bed reveal a region of strong momentum exchange at the interface, a penetration of turbulence into the porous region, and an overall discharge capacity that depends on flow regime [325]. Simulation of turbulent flow in fully packed beds shows that medium topology is a key determinant of turbulence quantities and flow when the transport equations are volume averaged [326,327]. Peristaltic transport in gravity driven channel flow has been analyzed via a perturbation expansion in terms of wave number to relate pressure rise to flow rate [328].

Wall heat and mass transfer rates in circulating fluidized beds were numerically modeled in two and three dimensions with good comparison to existing data for suspension to wall heat transfer [329–331]. Particle imaging in a three-phase, two-dimensional fluidized bed show the positive effect of increased particle collision frequency and the negative effect of solid hold up on heat transfer rate [332]. Direct simulation of wall region particle flow time was carried out for a sample size on the order of half-a-million particles to produce estimates of residence time, contact frequency, and contact distance [333]. Experiments on heat transfer to the standpipe of a circulating fluid bed boiler reveal a dilute and dense particle zone, each with a distinct heat transfer character [334], as well as the relation between local heat transfer coefficients and fluidization velocities [335,336].

The stability of flow to small disturbances in a porous channel has been modeled by analogy to the Hartmann problem in MHD. Circular duct flow is found to be stable for all Reynolds numbers but parallel channel flow exhibits a critical Reynolds number [337]. Rotating porous layers, such as encountered in alloy solidification exhibit both stationery and oscillatory modes of instability [338]. Oscillatory instability is also observed for shallow saturated layers when temperature and solute gradients are present [339].

Linear stability analysis for the annulus with a heat generating fluid likewise produces critical Rayleigh numbers parameterized by the radius ratio [340]. Similar problems are deduced for the anisotropic flat layer with a density maximum [341], non-uniform thermal gradients [342], a temperature dependent viscosity [343], and a viscosity dependent on magnetization [344]. The linear stability of the bottom-heated layer with convective boundary conditions is expressed in terms Rayleigh–Biot number relations [345]. An extension of this problem to case where local thermal equilibrium is absent is parameterized in terms of the interfacial heat transfer coefficient [346]. For porous layer filled with a visco-elastic fluid, linear and nonlinear stability criteria have been calculated, as well as supercritical bifurcations in the heat transfer coefficient [347].

A Karman–Pohlhausan analysis of forced convection from a plate with a thin porous surface layer shows how an increase of heat transfer coefficient is obtained that is independent of Darcy number [348]. Computation time for flow and heat transfer through narrow, fiber-filled porous channels can be significantly reduced via a one-dimensional approximate temperature profile [349]. Thermally developing forced convection in planar and circular duct flows has been analyzed using the classical Graetz methodology [350,351]. A temperature dependent viscosity in fully developed forced convection in a parallel plate channel can produce either an increase or decrease in heat transfer coefficient depending on cooling and heating at the wall [352,353]. Buoyancy effects on forced flow with internal heat generation and rotation in a vertical annulus show that the primary parameter that characterizes the convective heat transfer regime is the Richardson number [354].

Gross anisotropy in the solid matrix, such as fissures and drilled holes, in channel flow can lead to a reduction in Nusselt number but with a corresponding reduction in friction factor [355]. Pin fin heat sinks in an open channel flow have been successfully modeled as an anisotropic porous medium with thermal non-equilibrium, and a heat transfer correlation is proposed [356]. Turbulence effects on forced convection in a composite porous and open channel are modeled via an algebraic model to account for the interface momentum transport [357,358]. Heat transfer with transpiration through porous-walls under high heat flux is found dependent on the volumetric heat transfer coefficient, the effective wall conductivity, and the wall region flow [359]. Injection of an immiscible fluid into a saturated anisotropic domain exhibits a range fingering characteristics when modeled in terms of the component fluid pressures and temperatures, capillary effects, and matrix anisotropy [360]. A related study simulates the movement of each component, and mass fluxes are calculated by an entropy balance [361].

Normal shock propagation and reflection through incompressible porous material have been modeled via a weighted average flux method, and a comparison with shock tube experiments leads to a phenomenological model [362].

Free convection in a bottom heated square cavity with cooled side and top walls is analyzed as an extension of the Darcy–Bénard problem for a range of Darcy number, including pure fluid limit [363]. Non-Darcy and non-Newtonian effects and side wall heating are numerically analyzed via the boundary element method for shear thinning and thickening fluids [364]. Thermal non-equilibrium and non-Darcy effects for the square domain with a heat generating solid phase produce heat transfer results at variance with the assumption of local thermal equilibrium and the simple Darcy formulation [365,366].

Periodic boundary temperatures for the flat layer are shown to produce a minimum and maximum Nusselt number for free convection at specific phase differences [367]. For the vertical flat duct, walls with periodic temperatures produce an extremum in thermal convection at a unique wave number [368], but when the walls are physically wavy, decreases in Nusselt number due to secondary flows are observed [369,370]. The effects of boundary shape on free convection in layer-type systems have been investigated in a numerical study for a generalized doomed upper surface [371].

Free convection across a vertically partitioned porous-fluid enclosure when vertically averaged is shown to depend on the conductance of the partition with a specific case in good agreement with experiments [372]. Transient buoyant flow in an open-ended vertical channel partially filled with a porous medium has been analyzed to reveal the role of inertia on overall flow [373].

Doubly diffusive convection in a vertical enclosure with porous layers on the vertical walls has been numerically predicted for a range of flow conditions and wall anisotropy, and an optimum Nusselt number is found [374]. Soret effects in a shallow layer are to be equally well predicted by a parallel flow model when compared to a numerical solution, and multiple steady-state flows are found possible under a vertical stabilizing temperature gradient [375]. Thermosolutal convection in a vertical concentric cavity partially filled with a porous medium is shown to depend strongly on the coupling between Prandtl and Lewis numbers, and the partially filled cavity is shown to offer advantages in overall transport in comparison the completely filled cavity [376].

6.5. Coupled heat and mass transfer

The lattice Boltzmann method has been applied to three-dimensional domains for a binary immiscible mixture with particular focus on the boundary conditions for the particle distribution function [377]. Heat and mass transfer boundary conditions at a porous–fluid interface are a particular focus of an analytical study of proton exchange membrane fuel cells [378]. An effective continuum model has been developed to describe nucleation and growth of the gas phase from a supersaturated liquid in a porous medium driven by heat transfer up to the initiation of bulk gas flow [379].

The drying of weakly disordered capillary porous media with heat transfer has been developed using the pore network concept, and surface tension gradients are shown to be a significant factor in determining flow regimes [380]. The rehydration of capillary materials also has received attention via modeling and experiments on the effects of anisotropy [381].

Simultaneous heat and moisture transfer in textile materials with or without condensation and sorption has been investigated via analytical modeling involving capillary forces and coupled conduction and thermal radiation [382–384]. A related study determines the effects of pore size distribution and fiber diameter on the overall transfer rates [385]. Prediction of drying times for planar domains and irregular objects has been approached via numerical and analytical means, including inverse methods [386–389]. Experimental validation is reported as well.

The use of thermal forcing for drying of soils and clays has been modeled taking into account multiple effects, including porosity, capillary pressure, mechanical deformation, and a nonlinear constitutive relation [390] Experiments involving an embedded tenisometer have been reported as well [391]. Related work on the propagation of thermal waves is also reported [392].

Mass transfer in laminar viscoelastic flow with nth-order reaction over a stretching sheet as the source of reactants is modeled with a similarity solution that employs an exact solution for the velocity field [393].

Buoyancy driven heat transfer and mass transfer have been modeled with wedge flow solutions and also analyzed for thermal dispersion effects to predict Sherwood and Nusselt numbers [394,395]. Inverse methods have been applied to determine the concentration dependent heat source in a porous medium with buoyant convective mass diffusion over a fairly large range of Rayleigh number [396]. An a posteriori prediction of flame front location in an inert porous radiant burner has been made via a numerical model that includes a detailed kinetics model, the gray medium assumption, and an empirical interface heat transfer coefficient [397].

Combined heat and mass transfer in natural convection from a vertical plate in a non-Darcy medium is modeled via the fully coupled nonlinear similarity equations, and an explicit analytic solution is obtained [300]. A numerical study is reported on thermally induced turbulent free convection for Darcy flow with a comparison to geophysical field test data for the Yucca Mountain nuclear waste repository [398].

Free convection in the stagnation region of an exothermic catalytic surface is found to exhibit different solutions for small and large time for first-order reaction kinetics [399]. For reactive porous media, rigorously coupling the Boltzmann equation in the gas phase, heat conduction in the solid phase and interface condition leads to a system of equation where the effective diffusion tensors and solid phase geometry emerge as subsidiary problems [400]. Metal reinforced porous catalysts for domestic heating systems have characterized with respect to their fluid, thermal, and mass transport characteristics, and a prototype design has been developed for a domestic applications [401].

Experiments on freeze drying with radiation effects showed that the low conductivity of the dried layer controls the overall process without any significant mass transfer resistance [402]. Freezing of soils is modeled with the aim of detecting boundary temperatures that determine the formation of ice lenses [403]. The reverse process, melting of permafrost, is shown to involve free convection, which results in a gravity dominated shape in the melt zone [404]. The manufacture of metal matrix composites has been successfully modeled numerically as a phase change process with fluid injection into a porous mold [405]. The solidification of magma flows from volcanic eruption is approached with a temperature dependent permeability and the release of latent heat as a result of the degassing process [406].

7. Experimental methods

Researchers continue to develop measurement techniques important to heat transfer studies. These include those related to measurement of heat transfer, temperature, and of relevant flow characteristics as well as miscellaneous activities such as improvement of calorimetry. Some recent works present relatively novel techniques; others are refinement of past techniques with application to specific studies in which the methods are of particular relevance.

7.1. Heat transfer measurements

Several studies consider various types of infrared imaging and liquid crystals for measuring heat transfer. Still other studies are concerned with measurements in calorimeters. Infrared techniques to measure heat transfer with application to sea/surface interface transport have been described [407]. Use of a thermal transient with infrared imagery enables measurement of the heat transfer within a cooled metallic turbine blade [408]. An improved technique has been developed for transient heat transfer measurements using thermochromic liquid crystals [409,410]. Another transient liquid crystal technique can establish turbine hear transfer characteristics in the presence of film cooling [411]. A paper [412] describes innovations in holographic interferometric measurement of heat transfer. Laser spot heating of luminescent paint on an insulated model provides measurement of the local heat transfer [413,414]. An analytical solution, [415] indicates an optimal method for determining the heat transfer from an experimental cooling curve obtained during high-pressure processing. A novel transient liquid crystal technique [416] using a three-test strategy gives good results when measuring heat transfer coefficients.

The accuracy of flow microcalorimeters can be analyzed using transfer functions [417]. Calibration of a heat conduction calorimeter permits measurement of energy produced in mixing of two liquids [418]. A prototype reaction calorimeter uses an integrated infrared attenuated reflection probe for studying fast reactions [419]. An experimental analysis of a conduction calorimeter [420] indicates excellent reproducibility. Numerical simulation shows the two-dimensional heat flow in a membrane-based microcalorimeter [421].

7.2. Temperature measurement

An analysis indicates the effect of thermal conduction along the wires of a surface-mounted thermo-couple [422]. The transient response of thermisters can be approximated as a first-order system [423]. Hot wire anemometers used as fast response resistance thermometers provide simultaneous measurement of temperature and velocity [424]. The dissipation rate of the temperature variance in a jet has been measured with cold wire anemometry [425]. The use of a scanning thermal wave microscope [426] provides sub-micrometer resolution along a surface for a temperature-sensing chip. The real-time laser-based thermal reflectance from a heated liquid droplet impinging on a substrate can be used to determine the surface temperature [427]. A surface micromachining process can be used to fabricate a heated microchannel integrated with an array of pressure and temperature thermometers for precision measurement of temperature along the surface [428]. Analysis of a thin thermocouple used to measure air temperature in a radiosonde [429] shows the importance of diffusion at high altitude as well as the influence of radiation. Transient thin film heat flux probes have been used to determine temperature in a short duration Mach 6 flow [430]. An infrared technique can be used to determine the surface temperature of a heated capillary tube [431]. The use of an optical fiber with a sensing tip covered by metallic coating provides an effective black body for measuring temperature in a high temperature environment [432]. A novel fiber-optic Bragg grating sensor has been suggested for measuring local static and fluctuating temperatures on the surface of a heated circular cylinder in cross-flow [433]. When considering the use of phosphors for measuring temperatures in the hot section of a gas turbine, care must be taken because of the measurement's sensitivity to oxygen partial pressure [434].

7.3. Velocity measurement

A numerical study indicates the transient thermal response of a hot wire anemometer for different types of input function [435]. Different hot wire geometries are considered in studying the means for optimizing measurements of instantaneous turbulent energy dissipation [436]. A numerical investigation [437] indicates the effect of a solid boundary on velocity measurements in a boundary layer. A multisensor array [438] can be used to map the flow structure in a disturbed boundary layer. A wedge-shaped hot film probe permits measurement of flow properties, including kinetic energy of turbulence in a pipe flow carrying different types and shapes of particles [439]. Change in the structure supporting a hot wire anemometer strongly affects the influence of vibrations on measurements [440]. The geometry in a hot wire system used for measuring wall shear stress sensor can significantly affect the sensor's performance [441].

7.4. Miscellaneous

Schlieren and shadowgraph systems in conjunction with a short pulse infrared laser and high-speed camera apparatus indicate the characteristics of supercritical carbon dioxide flow [442]. A contact probe permits characterization of thermal conductivity with nanoscale spatial resolution [443]. Steady and unsteady gas flows are measured using an isothermal chamber through which the gas flows [444]. An ellipsoidal radiometer can separate radiation heat transfer from convection heat transfer in fire tests [445]. A transient system is used to measure the spectral directional emissivity of solid materials at high temperature [446]. An ultrasound technique has been suggested for measuring the interfacial heat transfer for aluminum alloy casting in a mold [447].

8. Natural convection-internal flows

8.1. Highlights

The majority of the published investigations employ numerical methods to obtain solutions to natural convection flows and heat transfer in classical configurations with various modifications to geometry, fluid properties and boundary conditions. Work is also being reported on the influence of multiple driving forces, fluid conditions and small particles that contain phase-change materials.

8.2. Fundamental studies

The influence of a combined magnetic driving force and buoyant natural convection has been studied in a cubic enclosure [448,449], a cylindrical container [450] and a shallow cylinder with Rayleigh–Bénard flow [451]. A critical evaluation of the Boussinesq assumption applied to gases was made [452]. Simulations of flows containing particles focussed on sedimentation [453] and the heat transfer enhancement caused by the addition of nanoparticles [454] and the use of a phase-change-material slurry [455].

8.3. Thermocapillary flows

Studies of thermocapillary flows include an experimental investigation of flows in liquid bridges for high Prandtl number fluids [456] and an analysis of the instability produced by thermocapillary motion for viscous two-layer flows [457]. Marangoni convection has been simulated for a cavity [458], a silicon melt [459] and a horizontal layer where the threshold for Hopf bifurcation was determined [460].

8.4. Enclosure heat transfer

Heat transfer in a vertical square or rectangular cavities continues to receive considerable interest with most of the work being numerical rather than experimental. The effect of thermoacoustic wave motion was studied [461] as was the effect of changing the gas pressure [462]. Kim et al. [463] obtained numerical solutions for transient natural convection in a square enclosure containing a simple power-law non-Newtonian fluid. Transient solutions were obtained after a sudden imposition of a gravitational vector [464] and with a periodic wall temperature boundary condition [465]. Several studies were performed to determine flow patterns [466], flow instability [467,468] and low level turbulence [469].

Variations on the vertical rectangular configuration were investigated including inclined cavities where none of the turbulent models employed were able to adequately predict the transition from laminar to turbulent flow in the boundary layers [470]. Aspect ratio, inclination and the effects of internal heat generation were studied in the laminar flow regime within rectangular enclosures [471]. Numerical solutions were obtained for the convection within an enclosure with various dome configurations comprising the top [472]. Circular and elliptical dome shapes resulted in higher heat transfer. The flow in a hemispherical enclosure was determined with uniform internal heating and isothermal walls [473]. Several papers were published that considered discrete heat sources on the floor of an enclosure [474,475] and distributed within the enclosure [476–478]. Other geometrical configurations considered include an enclosure with wavy walls [193,479], partially divided [480] and unobstructed [481] trapezoidal cavities, partially divided square cavities [482] and square cavities with triangular inserts in the corners [483].

Rayleigh–Bénard convection in horizontal layers has been studied experimentally where a laser-induced fluorescence method was used to provide quantitative spatially correlated temperature data in turbulent flow [484]. A theoretical study was performed to determine the effect of coupled natural convection and radiation when a radiatively participating medium is utilized [485]. The results showed that the presence of the radiative source generally increased the flow critical values. Evaporation from a thin liquid layer was found to provide a separate mechanism than Rayleigh–Bénard convection and Marangoni–Bénard convection [486]. Other studies include an investigation into the temporal fluctuations in heat flux [487], the effects of using a microemulsion slurry [488], the use of supercritical helium mixtures [489] and a modeling approach for Rayleigh–Bénard convection in a weakly turbulent state with free upper and lower surfaces [490]. Heat transfer correlations were obtained for horizontal layers of immiscible fluids that might occur in post-accident reactors [491]. An experimental study was performed to simulate the two-fluid convection that occurs between the earth's core and the mantle [492]. Several studies were conducted to quantify experimental errors introduced into laboratory scale investigations of Rayleigh–Bénard phenomena. The effect of the thermal coupling between a conducting base and the fluid was quantified [493]. The effects of the side walls on finite-sized enclosures was also investigated [494–496].

8.5. Cylindrical containers

Experimental and numerical studies were made of the transient flow and heat transfer within cylindrical hot water storage tanks [497,498]. Transient cooling of the upper surface was simulated for air and insulin containing cylinders [499]. Solutions using direct numerical simulations were obtained to study the effects of viscous boundary layers and mean flow structure within a thin cylindrical shell [500]. The flow and heat transfer within inclined cylinders were measured [501]. Convection coupled with thermal radiation was investigated experimentally for a vertical annulus with constant heat flux on the inner cylinder [502].

8.6. Horizontal cylinders and annuli

Turbulent natural convection was studied numerically for Rayleigh numbers up to 1010 in horizontal annuli to simulate the conditions found in gas insulated high voltage power cables [503]. Dual solutions were obtained for flow within a horizontal annulus with a constant heat flux prescribed on the inner cylinder [504]. Numerical results were presented for natural convection from a horizontal cylinder in a square enclosure [505] and in a horizontal annulus containing two immiscible liquids [506].

8.7. Thermal plumes

The impingement of a two-dimensional buoyant plume on a heated upper wall was studied numerically [507]. Flow regimes were observed in a laboratory setting using corn syrup and moving belts to simulate convection in the earth's mantle with moving plates above [508]. The plume from a line heat source was studied as it rose into a stratified region to determine the effect of smoke rise in a stratified atrium [509].

8.8. Mixed convection

The interaction between jet inflow at the bottom and flow out the top of a cavity with internal heat generation was studied numerically [510]. The effects of various turbulence models [511] and input uncertainties [512] were determined for ventilated enclosures.

8.9. Miscellaneous

Double diffusive processes were studied in a rectangular cavity containing a binary liquid mixture [513] and in an open cylinder filled with moist granular product [514]. The influence of buoyancy on wildfire behavior was investigated using the fire data set from the USDA Forest Service's Fire Science Laboratory [515]. A numerical study was conducted to determine the development of duct flows in fuel cells on buoyancy-driven secondary flow and mass transfer [516].

9. Natural convection-external flows

9.1. Vertical plate

The vertical semi-infinite flat plate continues to receive attention with variations in surface thermal and roughness conditions, fluid properties and combined heat and mass transfer. Transient flows and heat transfer were studied for a step change in surface heat flux [517] and a surface with uniform heat flux and surface roughness elements [518]. Laminar free convection was modeled from a plate with uniform heat flux immersed in a fluid with temperature dependent properties [519,520] and an isothermal plate immersed in thermally stratified water [521]. The development of longitudinal vortices was investigated near the transition to turbulent flow [522]. Other studies include a direct numerical simulation of viscous dissipation effects [523] and numerical solutions presented for heat transfer from a porous plate [524] and for combined heat and mass transfer [525].

9.2. Horizontal and inclined plates

Experimental measurements [526] and numerical solutions [527] have been obtained for heat transfer from horizontal plates of finite width. Experiments and numerical solutions were also presented for natural convection above a wavy heated plate [528,529]. Investigation of flow transition above a uniformly heated inclined plate [530] indicated that transverse and longitudinal roll perturbations were both important. Flow and heat transfer near an impulsively started inclined plate were studied [531]. The interactions between a bubble and the free convection flow from an inclined heated plate were determined using optical methods [532].

9.3. Channels

Simulations of heat transfer in vertical channels have been performed for a protruding heated module [533] and for flush-mounted heaters [534,535]. Heat transfer from an array of vertical parallel plates was studied to determine the optimum configuration for heat transfer rate per unit volume [536]. A vertical adiabatic extension above an asymmetrically heated channel was found to improve the heat transfer rate for some configurations but not for all [537]. The effects of a particulate suspension within a vertical channel were investigated including internal heat generation or absorption [538,539]. Thermally stratified boundary layers were successfully achieved in a wind tunnel [540]. The authors observed gravity waves in the middle and upper portions of all stable boundary layers. The flow in deep trenches was studied as the buoyant flow may limit the ion transport from an electrolyte bath above to the plating surface at the bottom [541]. Internal natural convection was found to dominate the initial fluid flow in HE II channels after the sudden application of heating on one end [542]. Inclined channels that were studied include a channel heated from the bottom with superimposed radiation [543] and a shallow open cavity with insulated side walls [544].

9.4. Fins

Fin efficiency calculated using an assumed uniform convective heat transfer coefficient was shown to differ significantly from the values determined using a locally varying natural convective heat transfer coefficient that depends on the local surface temperature [545]. Natural convection heat transfer from a short rectangular fin array above a heated base was studied including the effects of fin length, height and spacing [546]. Heat transfer from a horizontal cylinder with high conductivity [547,548] and low conductivity [549] fins showed the effect of both fin geometry and fin conductivity on the overall results.

9.5. Cylinders and cones

Natural convection about a suddenly heated horizontal wire was observed using speckle pattern interferometry [550]. The thermal inertia of a wire was found to play an important role in the initial transient heating when immersed in liquid nitrogen [551]. Investigations of natural convection heat transfer from a horizontal cylinder included the effects of the nearby surfaces [552], micropolar fluids [553], and conjugate conduction within the cylinder and the external natural convection flow [554]. Numerical solutions for transient heat transfer from a suddenly heated elliptical cylinder were presented [555] that covered the range of minor–major axis length ratio from 0.05 to 0.998. Local heat transfer coefficients have been determined along a vertical cylinder with a power-law wall temperature distribution [556]. Experimental measurements and asymptotic series solutions were reported for heat transfer from horizontal and inclined cones [557].

9.6. Plumes

The self-preserving properties of round buoyant turbulent plumes were observed in still fluids [558] and in a uniform cross-flow [559] using a water channel, a CCD camera and tracer dye. Large-eddy simulation of CO_2-containing plumes in the ocean were modeled [560] to study the feasibility of carbon sequestration in seawater. Several versions of the k–ε turbulence model were examined to determine the best method to model recently published experimental data on buoyant plumes [561].

9.7. Mixed convection

The Froude number for which the heat transfer from cylinders, plates and spheres deviates by 5% or more from the free convection value was determined [562]. Theoretical studies were reported for mixed convection from vertical [563,564] and inclined [565] plates and from a moving vertical cylinder surrounded by a porous medium [566]. Mixed convection was studied as applied to the effect of ground heating on a cloud [567] and the use of radiant cooling panels in a building [568]. A summary of research applied to horizontal channels heated from below was presented with recommendations given for future work [569]. Mixed convection was addressed as applied to the cooling of circuit boards [570] and heat transfer from MEMS devices [571]. Vortex rolls were observed above a heated, horizontal rotating disk with an air jet impinging from above [572]. Mixed convection from open cavities was studied numerically [573,574]. A direct numerical technique was used to study aiding and opposing flow adjacent to a vertical heated cylinder in turbulent flow [575]. Several studies were reported for mixed convection in vertical tubes [576] and vertical [577–581] and inclined [582] channels. Other configurations included the flow within horizontal tubes [583] and channels [584–586].

9.8. Miscellaneous

An experimental and theoretical study of natural convection heat transfer from cuboids was reported [587]. The natural convection induced by the absorption of laser [588] and UV [589] radiation was addressed. Other studies considered the influence of an aerosol contained in the fluid [590], the suppression of convection by a strong magnetic field [591], a use of dielectrophoretic force [592] and the entropy generated from a natural convection flow [593].

10. Rotating flows

10.1. Rotating disks

Interest in transport to rotating disks and from rotating fluids to a stationary surface has recently grown owing to the continual development of high density disk drives for data storage, high performance clutches, and the use of film flows for chemical processing wherein a rotating electrode is present. Theoretical work involved the use of similarity models for laminar convection [594], study of large amplitude wave formation [595] and numerical study of non-Newtonian fluid flow [596]. For permeable disks, theoretical and numerical studies of boundary layers, oscillating flow and rotating flow revealed the key parameters for the Nusselt number and skin friction coefficient and also for the occurrence of resonance [597–599].

Heat transfer between coaxial disk systems was investigated experimentally and theoretically to determine the local and overall heat transfer coefficients and the effects of rotational Reynolds number and spacing [600–602]. A numerical model for chemical vapor deposition in a rotating disk reactor resulted in the development of an experimentally validated global condensation parameter that controls the characteristics of particle population in the gap [603]. Experimental on the characterization of thin liquid films [604] showed the overall morphology of wave formation and the radial movement of the hydraulic jump, both dependent on a Reynolds number based on flow inlet gap height.

10.2. Rotating channels

Flow and heat transfer in rotating pipes and rectangular channels was the subject of mostly numerical study. The combined effects of rotation, curvature, torsion, and channel shape on Nusselt number and flow structure were the overall focus of the research. Analytical work that extends the Dean equations to rotating helical pipe flow focused on flow structure for a limited range of the Coriolis parameter [605], and heat transfer with the complicating factor of differential heating that creates significant buoyancy in a curved pipe was examined numerically [606,607]. Measurements with LDV successfully determined rotational effects on flow structure in smooth ducts connected by a 180-degree bend [608].

Heat transfer in a rotating channel system with through flow and impingement was numerically determined [609–611]. Various closure models were employed for three-dimensional turbulent flows [232], and the direct numerical simulation method was used for turbulent spanwise rotating channel flows [612]. For ribbed and dimpled channels, an extensive set of measurements were reported for a double pass channel to reveal flow structure and local heat transfer coefficients [613–619]. Experimental methods included LDV, naphthalene sublimation, liquid crystal thermography, imbedded heat flux and temperature sensors [620] and, and optical methods [621]. These studies were complemented by numerical work involving the averaged turbulent field equations [622] and large-eddy simulation methods [623].

10.3. Enclosures

Measurements of the flow structure and convective heat transfer using infrared thermography and LDV were reported for the air-gap of a rotor-stator system resulting in a correlation between the Nusselt and Reynolds numbers [624]. The flow field in an annular rotating flame holder was also measured using LDV such that a novel characterization for a stable flame is proposed [625]. Experiments on highly supercritical thermal convection in a hemispherical shell revealed the power law dependence of the Nusselt on the Rayleigh number, overall flow structure, and the scaling of motion to represent geostrophic flow [626]. Rotating annular flows were the subject of numerical and analytical studies that revealed the details of the flow field and that thermodynamics of the flows and heat transfer processes [627,628].

Modes of convection, stability of flow, and combined convection with thermal radiation began to receive attention in connection with geo- and astrophysical systems. Superfluidity in star interiors, transient cooling and shrinkage of the earth's core, and the development of Rossby waves in rapidly rotating neutron stars were particular focal areas [629–631].

10.4. Cylinders, spheres, and bodies of revolution

Geophysical flow and heat transfer were investigated as a transient three-dimensional problem for a rotating sphere with surface flowing and at small Reynolds number to reveal three wake regimes and a relation of the heat transfer to that for evaporating droplets [632].

Simulation studies continued on crystal growth techniques as found in Czochralski furnaces of various configurations and operational modes to reveal the details of the flow field [633,634]. Both experimental and numerical work was reported on convection in crystal growth in phosphoric acid solutions with a rotating crystal of axial symmetry [635]. Details of the flow fields for the Brigdman and Stockbarger methods were calculated to development parameters on dopant or impurity levels [636–638].

11. Combined heat and mass transfer

11.1. Laser ablation

Researchers modeled the ablation of gold films in vacuum via an ultra-short (sub-picosecond) laser pulse [639]. The computed electron and lattice temperatures agreed well with experimentally obtained data. Researchers also developed a model (including chemical kinetics) for the expansion of a plasma, resulting from laser ablation of titanium metallic targets [640]. A one-dimensional, two-step model was developed to account for the difference between electron temperature and lattice temperature in the laser processing of metal targets [641]. A model for supercritical ablation was proposed in which the vapor density is limited by transparency [642]. The accuracy of the model is dependent on material and temperature and results suggest that at higher temperatures, the proposed supercritical ablation mechanism performs better when breakdown in the gas-phase is taken into account. Researchers also developed a k–ε-based approach to model the heating of titanium and nitrogen diffusion in solids [643].

11.2. Film cooling

Researchers studied the effects of free-stream turbulence on the film cooling of a flat plate [644]. Three blowing rates were utilized in flow configuration in which a uniform density jets issued from three holes located three diameters apart. The film cooling characteristics of a single round hole issuing into cross-flows was studied under different blowing ratios and Reynolds numbers [645–647]. Researchers also investigated the number of holes, orientation angle, and the shape of holes [648–650]. The effects of tabs and ribs on downstream heat-transfer/cooling were also considered [651–653]. Computational methods were used to study hypersonic laminar film cooling [654]. Additionally, large-eddy simulation was used to investigate the film-cooling of a turbine blade [655]. The approach is superior to traditional Reynolds-averaged Navier–Stokes simulations in the sense that both the anisotropy and large-scale dynamics are captured. The effects of chemical reactions near the walls were investigated [656]. The blowing ratio and Damkohler number were varied to capture the effect of heating on the wall. Infrared thermography was used to study aero-thermal conditions in different combustion zones and how they were affected by multi-hole plate geometry [657]. Researchers also studied the heat transfer and film cooling effectiveness on the squealer tip of a gas turbine engine [658].

11.3. Submerged jets

The heat transfer characteristics of an annular turbulent impinging jet with a confined wall was studied [659]. Other studies include a laminar jet impinging with a confined wall, including buoyancy [660], swirling jets [661,662], turbulent jets impinging on a circular disk [663,664], jets impinging on inclined surfaces [665–667], jets impinging on rectangular tabs [668], the impingement of under-expanded jets [669], pulsating jets [670], and synthetic jets for the cooling of electronics [671]. Researchers considered the use of submerged jets for the synthesis of materials via chemical vapor deposition [672], and the cooling of an airfoil leading edge [673]. The gas dynamics of supersonic jet impingement was also studied [674], as well as the heat and mass transfer characteristics in an impingement cooling system under cross-flow [675]. A number of computational studies were also performed. These included the use of k–ε models, linear and nonlinear, to predict flow and heat transfer characteristics [676,677], simulation of microscale jets [678], heated, pulsed jets [679], chemical vapor deposition processes [680], the impingement of planar jets via large-eddy simulation [681], and the use of a Reynolds stress turbulence model for simulating jet impingement onto a single hole [682]. Chemical reactions were also investigated. Researchers considered a row of butane/air flames impinging on a flat plate [683,684]. Additionally, a new probe technique for the measurement of species concentration in binary gas mixtures was developed [685] as well as the heat transfer due to the impingement of a reciprocating jet-array on a piston for the cooling of heavy-duty diesel engines [686].

12. Bioheat transfer

The present review is only a small portion of the overall literature in this area. This represents work predominantly in engineering journals with occasional basic science and biomedical journals included. This is a very dynamic and cross disciplinary area of research, and thus, this review should be taken as more of an overview, particularly from an engineering point of view, rather than an exhaustive list of all work in this area for this year. Subsections include work in thermoregulation (thermal comfort and physiology), thermal therapies and cryobiology.

12.1. Thermoregulation

Work in thermoregulation was comprised of several subareas including: Biomedical or clinical applications of warming or cooling, and physiological assessments of thermoregulation. In the biomedical/clinical area reports focused on comparison of forced-air warming systems with lower body blankets in manikins [687] as well as a randomized trial for heat transfer using upper body blankets in volunteers [688]. Other translational model systems were used to study the effects of peripheral and central warming on body temperature during canine laparotomy [689] and endovascular cooling and rewarming for induction and reversal of hypothermia in pigs [690].

Physiological assessments of thermoregulation reported heat transfer to and from human beings with and without clothing, i.e. thermal comfort, as well as heat transfer within human tissues including blood flow changes. In the thermal comfort area several reports studied the variation of clothing thermal insulation during sweating [691] and during thermoregulation and exercise [692]. Thermal comfort modeling work included an integrated human-clothing system for estimating the effect of walking on clothing insulation [693]; and a model of the flow and heat transfer around a seated human body by computational fluid dynamics [694]. Other thermoregulatory work at the level of heat transfer and blood flow within tissues reported baroreflex control of pulse interval changes during heat stress in humans [695] and muscle temperature transients before, during, and after exercise [696]. Further work included investigation of the role of porous media in modeling flow and heat transfer in biological tissues [697]; the effect of blood flow on thermal equilibration and venous rewarming [698]; a model of species heat and mass transfer in a human upper airway model [699] and a computational thermodynamics analysis of vaporizing droplets in the human upper airways [700].

Thermoregulatory physiological studies were also carried out in reptiles to assess seasonal thermoregulation in the American alligator (Alligator mississippiensis) [701], and the effect of heat transfer mode on heart rate responses and hysteresis during heating and cooling in the estuarine crocodile Crocodylus porosus [702]. One last study assessed thermal windows on the trunk of hauled-out seals: to assess these as possible hot spots for evaporation as a thermoregulatory control mechanism [703].

12.2. Thermal therapy

The area of thermal therapies has the highest representation in this section. Thermal therapies can be hyperthermic (energy source) or cryothermic (energy sink) technologies. The hyperthermic studies included both studies where hyperthermia was the treatment as well as where hyperthermia a side effect. Studies which reported hyperthermia as a side effect of another treatment included modeling of heat generation and temperature distribution in drilled bone [704] and temperature modeling in a total knee joint replacement using patient-specific kinematics [705]. Hyperthermic treatment studies included an analysis of the thermal action of a short light pulse on biological tissues [706]; a vascular model for heat transfer in an isolated pig kidney during water bath heating [707]; the effect of perfusion on the temperature distribution during thermotherapy [708]. Heat shock protein 70 gene therapy combined with hyperthermia using magnetic nanoparticles [709]; effect of the directional blood flow on thermal dose distribution during thermal therapy [710]; model-order reduction of nonlinear models of electromagnetic phased-array hyperthermia [711]; a temperature-based feedback control system for electromagnetic phased-array hyperthermia [712]. Additional work included 3-D modeling of electromagnetic fields in local hyperthermia [713]; the clinical use of the hyperthermia treatment planning system hyperplan to predict effectiveness and toxicity [714]; inverse optimizing method of bio-temperature-field reconstruction in rf-capacitive hyperthermia [715]; edge-element based finite element analysis of microwave hyperthermia treatments for superficial tumors on the chest wall [716]; inter-species extrapolation of skin heating resulting from millimeter wave irradiation: modeling and experimental results [717]. Further work included optimization of a beam shaping bolus for superficial microwave hyperthermia waveguide applicators using a finite element method [718]; heat-directed suicide gene therapy for breast cancer [719]; heat-directed tumor cell fusion [720] and Joule heating during solid tissue electroporation [721].

Cooling and cryothermic work included theoretical modeling, experimental studies and clinical simulations of urethral cooling catheters for use during prostate thermal therapy [722]; methodology for characterizing heat removal mechanism in human skin during cryogen spray cooling [723]; effect of spurt duration on the heat transfer dynamics during cryogen spray cooling [724]; and cooling efficiency of cryogen spray during laser therapy of skin [725]. In the cryotherapy area work included a general model for the propagation of uncertainty in measurements into heat transfer simulations and its application to cryosurgery [726]; and a cryoheater as a means of cryosurgery control [727]. One final study assessed local cryogen insults for inducing segmental osteonecrosis [728].

Several additional studies were reported that are related to thermal therapy. One report studied cell volume changes during rapid temperature shifts [729]. Several other studies reported that low power millimeter wave irradiation exerts no harmful effect on human keratinocytes in vitro [730], while another assessed local heating of human skin by millimeter waves [731]. One final report assessed the sensitivity of the skin tissue on the activity of external heat sources [732].

12.3. Cryobiology

This is a small subsection of this bioheat review since most of these papers are carried in the journals Cryobiology, Cryo-Letters and Cell Preservation Technology which are non-engineering journals. Within the journals reviewed here, studies included a simulation of microscale interaction between ice and biological cells [733]; freezing curve-based monitoring to quickly evaluate the viability of biological materials subject to freezing or thermal injury [734]; and a non-Fourier heat conduction effect on prediction of temperature transients and thermal stress in skin cryopreservation [735]. The cooling therapies noted in Thermal Therapies above are also cryobiological in nature. It should also be noted that the bulk of the cryobiological literature is concerned with preservation of cells and tissues in the frozen state which is not clearly reflected in the articles reviewed here.

12.4. Bioheat general

General studies in the area of bioheat transfer are listed here. These studies included development of a heat transfer model for plant tissue culture vessels [736]; how bees can heat empty broodnest cells [737]; and the influence of transport phenomena during high-pressure processing of packed food on the uniformity of enzyme inactivation [738].

13. Change of phase-boiling

Papers on boiling change of phase for 2003 have been categorized as follows: droplet and film evaporation, bubble characteristics and boiling incipience, pool boiling, film boiling, flow or forced convection boiling and two-phase thermohydrodynamic phenomena. These topics are discussed in their respective subsections below.

13.1. Droplet and film evaporation

Electrospray evaporation and deposition on a heated substrate is analyzed [739]. Accounting for Rayleigh limit of charged droplets leads to acceleration of their evaporation when high substrate temperature or small droplet diameters are employed. The interaction of transfer processes in evaporation of semi-transparent liquid droplets is modeled [740]. Evaluation of thermoconvective stability is presented. Effects of gravity and ambient pressure on liquid fuel droplet evaporation are computed [741]. Enhancement due to natural convection becomes more dominate with increasing ambient pressure due to the increase in the Grashof number. Heat transfer from a liquid to an evaporating drop is computed [742]. Most of the heat transfer takes place in a small region at the contact circle of the three phases. Effects of dissolved salts on water sprays are measured [743]. Dissolved salts prevent bubble coalescence. Modeling of droplet evaporation with the distillation curve model is discussed [744]. The major advantage of the new model is that algebraic expressions are derived for multicomponent vaporization. Modeling of spray evaporation with a droplet number moment approach is applied to a wide variety of different sprays [745].

An evaluation is made of simple evaporation models for spray simulation [746]. Film thicknesses are calculated which represent realistic heat and mass transfer processes around a droplet. A parabolic temperature profile model for heating of droplets is suggested [747]. Application to fuel droplets in realistic diesel engines is verified. Molecular Dynamics (MD) is applied to droplet evaporation [748]. The vaporization process consists of an initial liquid heating stage during which vaporization rate is relative low, followed by nearly constant liquid temperature evaporation at a "pseudo wet-bulb" temperature. Numerical analysis is presented for droplets in multicomponent gaseous mixtures [749]. It is shown that in the case of large concentration at the droplet surface, boundary conditions for concentration jump obtained from kinetic theory and those obtained from Fick's law yield the same results.

Measurements are made for impacting water mist on high temperature metal surfaces [750]. The total heat transfer coefficient can be established as a summation of two effects, one for air heating and one due to the liquid mass flux. A similar experiment uses an air–liquid nitrogen mist jet impinging on a superheated flat surface [751]. An enhanced heat transfer region centered on the stagnation point is discussed. Experiments are conducted on evaporation of a water–ethanol mixture sessile drop [752]. In the first stage of evaporation, ethanol diffuses to the interface where it dictates the surface tension properties and hence the wetting angle. Measurements are presented of the flame structure at the base of a pool fire where water mist is introduced [753]. Extinction is obtained by rapid and total clearance of the liquid, rather than from reduction of the burning rate. Evaporation of embedded liquid droplets from porous surfaces is visualized using magnetic resonance imaging [754]. Transport of liquid by capillary diffusion has a strong influence upon the evaporation process. The effects of evaporation on resonant photoacoustics of aerosols are measured [755]. A theory of photoacoustics for volatile aerosols is developed. Characteristics of spray cooling in a closed loop are described [756]. Air purposely introduced in the spray has a significant influence on heat transfer characteristics. Experimental results in spray cooling are presented [757]. The advantage of surfactant addition to the spray is investigated.

A model is presented for the turbulence effects on droplet evaporation [758]. Ambient turbulence levels are varied from 1% to 60% and integral length scales of turbulence is varied from 0.5 to 20 times the diameter.

Temperature and volumetric fraction measurements are made in a hot gas laden with droplets [759]. Two temperatures are found, the difference between the two is shown to be proportional to the water volumetric fraction in the flow. The absorption of thermal radiation in a semi-transparent droplet is calculated [760]. Variations of reflective index of diesel fuel with wavelengths can smooth the predicted radial dependence of the thermal radiation power absorbed in the droplets. The effects on quenching a hot surface of dissolving salts in the water spray are measured [761]. Addition of $MgSO_4$ reduces the time required to cool a hot surface.

Simultaneous heat and momentum transfer in two-phase film systems is studied [762]. Application is to the removal of highly volatile fractions from high-boiling point liquids. An analysis is presented for non-stationary evaporation kinetics [763]. It is shown that evaporation does not change the temperature of the liquid interface. A continuation study investigates the stability of the equation [764]. Analytical expressions are proposed for evaporation of water into a stream of dry air, humidified air or superheated steam [765]. Special emphasis is devoted to the inversion temperature and how its value is affected by humidity, mass flow rate and geometry. In a similar paper, numerical analysis is applied [766]. Mixed convection heat and mass transfer rates with liquid film cooling of an insulated vertical channel are computed [579]. Latent heat transfer is the main mechanism for heat removal. Evaporation and combustion of liquid fuels through a porous medium are discussed and a down-flow compact burner system is developed [767]. The effects of various parameters are clarified to confirm the improvements in mixing of the fuel vapor/air mixture. Experimental results are presented for heat transfer in a cryogenic tank [768]. The dominant heat transfer modes are radiation in the isolating cavity, conduction in the neck near the liquid phase and convection between the inner wall of the neck and the cold vapor coming from the liquid bath. Experimental results are presented which describe the effects of hydrophilic surface treatment on evaporation heat transfer at the outside wall of a horizontal tube [769]. During evaporation, the high wettability of the surface obtained through the treatment induces film flow in the tubes while sessile drops are formed in untreated tubes. Measurements are made of the vaporization rate of cesium from molten slag in a plasma melting furnace [770]. Results suggest that the vaporization rate is controlled by vaporization from the free molten slag furnace to the gas phase which depends on the thermodynamic properties of the molten slag. The surface temperature of an evaporating liquid is computed [771]. It is hypothesized that the deviation from similarity between heat and mass transfer is described by the first power of the Lewis number. The linearized Boltzmann equation for rigid-sphere interactions is used to compute heat transfer and evaporation rates [772]. The Maxwell gas-surface interaction law is solved for cases of different accommodation coefficients. A model is presented for flow and heat transfer of an evaporating extended meniscus in a microcapillary channel [773]. The length of the extended meniscus region is affected by the heat flux, the channel height and the dispersion constant.

The interfacial evaporation of an aqueous solution of SDS surfactant self-assembly monolayer is studied [774]. The mechanism of interfacial evaporation in boiling heat transfer with application to SDS surfactants is addressed. A non-equilibrium van der Waal model is applied to the interface between a vapor and a liquid [775]. How evaporation and condensation fluxes result as a consequence of changing pressure away from the co-existence pressure is discussed. Enhancement of evaporation from a lake by entrainment of warm dry air is measured [776]. Implications of climate variability on mechanisms that control short and long-term evaporation rates are discussed.

A two-phase zone with condensation in a porous medium is analyzed [777]. Condensation and evaporation occurring within the boundary layers near the edges of a two-phase zone are examined. The first falling rate period during drying of a porous material is characterized [778]. The model allows determining the internal profile of moisture and the penetration of the drying front during the falling rate period.

The effects of evaporation coefficient and temperature jumps on thermophoresis of a particle in a binary gas mixture are analyzed [779]. Thermodiffusion terms, Stefan effects and heat flux associated with convective transfer of evaporating mass are taken into account. An evaporation theory for deformable soils is presented [780]. A column drying test is conducted to document the one dimension water flow, heat flow and evaporation in the surface. Drying characteristics of a porous material in a fluidized bed of fluidizing particles with superheated steam is examined [781]. The effect of the bed temperature on the drying characteristics is significant, while that of the mass velocity of the drying gas is slight.

13.2. Bubble characteristics and boiling incipience

Experimental results which document microscale transport processes during the evaporation of a constrained vapor bubble are presented [782]. Film thickness profiles are measured using image analyzing interferometry. An analysis is presented for the violent collapse of a non-spherical bubble [783]. Applications include cavitation in fluid machinery and ultrasonic cleaning. Results of an analysis of bubbly nozzle flow with heat, mass and momentum interactions are presented [784]. The bubbles are made of non-condensable gasses and condensable vapor. The model allows for momentum and thermal lags as well as mass transfer between the gaseous and liquid phases due to evaporation and condensation. The growth and collapse processes of microbubbles under pulse heating are investigated [785]. To evaluate the perturbation area of the microbubble, submicron particles are placed in the fluid and their dynamic responses during the transient bubble formation are recorded. A numerical analysis is presented of the dynamics of toroidal bubbles considering the heat transfer to the internal gas [786]. It is shown that a violent collapse induces an extremely high-pressure region near the point of liquid microjet impaction on a nearby rigid wall. The effects of surfactant concentration on the initial short time scale Marangoni convection around a boiling nucleus are computed [787]. The maximum circulation strength, which is dependent on the bubble size, corresponds to a characteristic surfactant adsorption time. A theoretical model is used to investigate nucleate boiling of binary mixtures [788]. Documented is how the bubble site density and the departure diameter vary with composition of the liquid. Experimental results show the bubble sweeping and jet flows during nucleate boiling of subcooled liquids [789]. The processes of the bubble sweeping phenomenon are described in detail and the effects on heat transfer are argued. From the same lab are measurements from a small wire to further illuminate the sweeping processes [790]. An analysis is made of vapor spreading near the boiling crisis [791]. At large heat flux, a recoil force tends to spread the vapor bubble that otherwise would not wet the solid.

The effects of temperature on the rise of a single bubble in stagnant water are documented by visualization [792]. Documented also are rise path oscillations and how the rise is affected by water purity. Heat transfer enhancement due to sliding bubbles is measured [793]. Three regimes of bubble motion are observed: spherical, ellipsoidal and bubble-cap. A theoretical model is presented for nucleate boiling heat and mass transfer of binary mixtures [794]. The model indicates that a considerable amount of the total heat flow passes through a tiny thin film area, called the microregion, where the liquid vapor phase interface is attached to the wall. A model is presented for computing the incipient point of net vapor generation in low flow subcooled boiling [795]. The model is an energy balance where the heat transfer needed for vapor generation equals the heat transfer needed for condensation. Experimental results are presented to describe boiling incipience of highly wetting liquids in horizontal confined spaces, such as the space between a heating cylinder and a disk. [796]. Smooth and porous disks are used as the non-heating walls. Boiling is found to first appear on the non-heated porous wall under some conditions. A model is presented for determining the active nucleation site density in a boiling system [797]. The model can be used for both pool and flow boiling systems. Experimental results show quasi-homogeneous boiling nucleation behavior on a small spherical heater in microgravity [798]. An analysis is presented and the results are shown to agree well with the measurements. Experiments are conducted to document the onset of transient nucleate boiling from a thick flat sample [799]. Results show that the temperature at boiling incipience is strongly influenced by the transient procedure, such as the waiting period between a preliminary procedure and heat input or an initial subcooling of the surface.

13.3. Pool boiling

A new model is presented for the heat transfer mechanisms in the vapor mushroom region of saturated nucleate pool boiling [800]. The relative influences of microlayer evaporation and Marangoni convection are considered. The effects of coalescence of bubbles from various sites are documented by producing dual or multiple individual bubbles from a microheater [801]. Multiple coalescences could take place with a group of bubbles. The heat flux level is proportional to the number of bubbles involved and the separation distances between bubbles. An experiment is conducted to simultaneously observe the dynamic behaviors of bubbles and dry spots on boiling surfaces [802]. The Critical Heat Flux (CHF) is initiated from locally limited nucleate boiling activity rather than any hydrodynamic instability. A numerical model is employed to simulate pool boiling [803]. The model captures the fundamental characteristics of boiling phenomena. Bénard-Marangoni instability is studied to describe interfacial non-equilibrium effects in a liquid vapor system [804]. The influences of evaporation parameters and of the presence of inert gases on the marginal stability curves are discussed. An inverse heat conduction analysis is employed to determine the local heat transfer coefficient for nucleate boiling on a horizontal cylinder [805]. Influences on measurement error due to thermocouple error or thermocouple placement error are quantified.

Interactions of nucleation sides in pool boiling on artificial surfaces are measured [806]. Three significant effects are found: hydrodynamic interaction, thermal interaction, and horizontal and declining bubble coalescence. Experiments are conducted to document nucleate boiling heat transfer enhancement in confined spaces, two horizontal surfaces, the lower is a heated solid and the upper is an unheated screen [807]. Generally, heat transfer is enhanced, for the mesh kept primary vapor bubbles forming coalescence bubble at low heat fluxes and allowed the vapor to escape at high heat fluxes. At high heat fluxes, vapor mushroom behavior over the mesh screen is not significantly different from that in unconfined pool boiling.

A stabilized heater surface is used to investigate subcooled pool boiling [808]. The heater allowed studying the mechanisms for the regimes of constant heat flux and constant temperature. A constant wall temperature condition is used to document partial nucleate boiling on the microscale heater [809]. The measured heat flux shows a discernable peak in the initial growth region, reaching an almost constant value. A constant wall temperature heater is used to study the growth of a single bubble in a saturated pool [810]. Proposed is that the data can be used to study boiling phenomena. An indium tin oxide coated transparent surface is used to study nucleate boiling [811]. Data on bubble size and nucleation site density are obtained. Experimental data are gathered for pool boiling in vertical/horizontal, V-shaped geometries [812]. The results reveal the importance of the angle to the enhancement of nucleate boiling heat transfer on structured surfaces. Pool boiling from microporous, square, pin-finned surfaces is experimentally documented [813]. The enhancement of CHF due to increased subcooling is greater for the microporous surface than for the plain surface. Boiling from microfabricated structures is documented to support optimization of the dimensions for maximizing heat transfer [814]. The larger pore and smaller pitch of the microstructured surface results in higher heat dissipation at all heat fluxes. Nucleate boiling characteristics from coated tube bundles are experimentally documented [815]. At low heat flux, the vertical-in-line tube bundles show the highest performance. A review of boiling from surface microstructures for application to electronic components is presented [816]. A primary issue is mitigation of temperature overshoot at boiling incipience. The values of CHF in a hemispherical narrow gap are documented [817]. Critical heat removal rates under various conditions are documented. Periodicity and bifurcations in capillary tube boiling with a concentric heater wire are documented [818]. Bifurcation from a periodic to a two-period state is observed to be due to lateral instability of the liquid film adhering to the capillary wall. Boiling of liquid fingers into superheated fractured rock is analyzed [819]. A parameter is offered that provides a quick estimate of the relative significance of boiling at a give location. A semi-empirical model is presented for boiling from enhanced structures [820]. Improvements are made to submodels for bubble departure diameter, evaporation within the channels and convective heat transfer from the external surfaces of the structure. A correlation of surface property effects in pool boiling of dielectric liquids is presented [821]. It predicts a broad range of effects such as pressure, subcooling and length scale. A model for boiling of HeII in porous structures in microgravity is presented [822]. The model is used to study the influences of parameters of the experiment on the characteristics of the vapor film. An analysis for boiling off pin fins under multiboiling conditions is presented [823]. The effects of the base temperature difference of the conduction–convection parameter and of the Biot number are analyzed and presented. Experimental results are presented for boiling off silicon chips with micro-pin-fins immersed in the fluid [824]. The maximum value of allowable heat flux was four times as large as that for a smooth chip. The effects of surface wettability on fast transient microboiling behavior are measured [825]. The surface is modified with hydrophobic and hydrophilic alkanethial Self-Assembled Monolayers (SAM). The surface modified with SAM exhibits lower boiling nucleation temperatures, more pronounced inflection points and higher average temperatures during microboiling. Pool boiling with superhydrophilic surfaces is experimentally documented [826]. The surface is created with TiO_2 exposed to (near zero contact angle) or shielded from (increased contact angle) UV light. Experiments are made to document natural convection boiling in an internally heated annulus [827]. They are with different heat fluxes impressed over the steel tube and are repeated for two submergence levels of the liquid in the down-flow pipe. The effects of pressure, subcooling and dissolved gas content on pool boiling from microporous surfaces are experimentally documented [813]. The effects of dissolved gas are generally small; however, as the dissolved gas content increases, more of the nucleate boiling curve is affected. Nucleate boiling of halocarbon refrigerants on cylindrical surfaces are experimentally studied [828]. An empirical correlation formulated in terms of reduced pressures is proposed. Boiling heat transfer coefficients for halogenated refrigerants are measured [829]. The new correlation shows good agreement with data. From the same lab are measurement results for HFC32, HFC125 and HFC134a [830]. A review of experimental studies is presented for boiling of binary mixtures of hydrocarbons [831]. Data for boiling of the non-azeotropic binary mixture (water/ammonia) on a horizontal surface are presented [832]. The framework for a semi-theoretical model for predicting pool boiling heat transfer of refrigerant/lubricant mixtures on a roughened, horizontal, flat surface is presented [833]. Comparisons are made against data from 13 different mixtures. The effect of nanoparticles on CHF of water in pool boiling is experimentally evaluated [834]. A 200% increase of CHF is recorded but no significant change is observed in the nucleate boiling performance. Another similar study records a reduction of boiling heat transfer performance with nanoparticles, though they note an improvement in single phase heat transfer with nanoparticles [835]. Experiments with pool boiling of nanofluids on horizontal narrow tubes note a degradation of boiling performance [836]. They note a smaller deterioration with narrow tubes than with industrial size tubes. Transport of salts or micron-sized particles entrained from a boiling water pool is documented experimentally [837]. The influences of nucleation and natural convection are demonstrated during slow depressurization of the facility.

An experimental study of miniature-scale pool boiling is presented [838]. The boiling curve obtained from the microheater is composed of two regimes which are separated by a peak heat flux. As the heater size decreases, the boiling curve shifts toward higher heat fluxes with corresponding higher superheats. Experiments are performed on saturation boiling of HFE-7100 from a copper surface that simulates a microelectronic chip [839]. The effects of inclination are documented. The effects of tube inclination on pool boiling heat transfer rates are measured [840]. The heat transfer coefficient changes from a minimum in a horizontal tube to a maximum in a vertical tube. Boiling in an inclined porous layer is numerically documented [841]. It is found that boiling depends strongly on the inclination angle. Boiling within a particle bed is experimentally studied [842]. The boiling heat transfer is enhanced greatly by adding the solid particles into the liquid, whether a fixed particle bed or a fluidized particle bed.

Electrohydrodynamic effects on isolated bubbles in a nucleate pool boiling regime are documented [843]. The isolated bubbles are recorded with a high-speed video camera.

13.4. Film boiling

Thermal fluctuations during transition from nucleate to film boiling on a wire heater are investigated to describe the $1/f$ noise characteristics of the crisis [844]. Singularities of this process are described [845]. The process is self-oscillatory. Mechanisms for emergence of oscillation are suggested. Special features of film boiling on a wire are discussed [846]. The existence of a region of self-oscillatory instability of heat transfer is revealed. Dryout and rewetting in a subcooled two-phase flow in a narrow channel are investigated [847]. Correlations of flow reversal with dryout/rewet are discussed. The effects of flow obstacles on film boiling are experimentally documented [848]. The results of flow obstacle enhanced heat transfer downstream of the obstacle and the promotion of rewetting are documented. The minimum heat flux for a water jet boiling on a hot plate is analyzed [849]. Simplified two-phase flow boundary layer equations are used. Two thermal Kolmogorov microscales of pool film boiling are discussed [850]. An extension to liquid metals is proposed. Melt droplet fragmentation following vapor film destabilization by a trigger pulse is modeled [851]. Application is the analysis of the effects of molten corium entering a pool of water. Heat transfer by radiation through a vapor gap in film boiling is modeled [852]. Practical recommendations are given for calculating the distribution of absorbed radiation. A look-up table is provided for determining heat transfer coefficients of film boiling heat transfer in vertical tubes [853].

13.5. Flow boiling

Classical thermodynamics is applied to flow boiling heat transfer [854]. The average temperature difference in a heated channel is shown to be tightly connected with the thermodynamic efficiency of a theoretical, reversible heat engine placed across this temperature difference.

Important processes that must be considered when channel diameters decrease are examined [855]. These include flow distribution issues in single, parallel, and split flows; flow instability in parallel passages, manufacturing tolerance effects; single-phase heat transfer; nucleation processes; boiling heat transfer and pressure drop; and wall conductance effects. A new version of a two-phase flow model is developed for liquid gas and liquid–liquid two-phase mixtures [856]. The differences of pressure, temperature and velocity between the two phases are taken into account. High heat flux removal of a plasma-facing component or an electronic heat sink, which involves conjugate heat transfer, is discussed [857]. Boiling curves are presented and compared with single-sided heated circular tube data. Convective boiling and two-phase flow characteristics inside a small horizontal helically coiled tube are measured [858]. A new flow boiling heat transfer correlation is proposed to better correlate the data. Visualization results are presented for periodic boiling in silicon microchannels of trapezoidal cross-section [859]. Large-amplitude, long-period boiling fluctuations can be sustained when the fluctuations of pressure drop and mass flux have phase differences. A two-phase flow pattern map for evaporation in horizontal tubes is presented [860]. A simpler method of calculating the transitions is given. Saturated flow boiling of water in a vertical, small-diameter tube is experimentally documented [861]. A heat transfer prediction method is proposed to reproduce the heat transfer coefficient within the flow pattern regime. Boiling heat transfer and dryout phenomena of CO_2 in a horizontal smooth tube are measured [862]. The heat transfer coefficient for CO_2 is on average 47% higher than that of R134a at the same operating conditions. Flow boiling in a two-phase microchannel heat sink is measured and a prediction method is presented [863,864]. The unique nature of flow boiling in narrow rectangular microchannels is discussed. Size and shape effects on two-phase flow patterns in microchannel forced convection boiling are discussed [865]. A physical mechanism based on the force balance across the vapor–liquid interface and the development of a restoring force is proposed to explain flow visualization results. A study of the Point of Net Vapor Generation (PNVG), done with aid from neutron radiography, in subcooled boiling flow along narrow rectangular channels with short heating lengths is presented [866]. Improved modeling based upon these results is proposed. Interfacial area transport of vertical upward bubbly two-phase flow in an annulus is measured [867]. The dominant mechanism in interfacial area transport is strongly dependent on the initial bubble size. Modeling of bubble layer thickness for formulation of a one-dimensional interfacial area transport equation is presented [868,869]. Such model is applied to vertical upward bubbly two-phase flow in an annulus [870]. Boiling in capillary tubes is discussed [871]. The temperature distribution of the heated tube surface is studied for various flow regimes. Subcooled flow boiling in narrow passages is experimentally documented [872]. There is no evidence that convection suppresses the nucleate term or that nucleation events enhance the convection term. Measurements in unsteady convective boiling in heated minichannels are presented [873]. A steady state is characterized and a non-steady flow is documented. Measurements are taken of forced convective boiling heat transfer in microtubes at low mass and heat fluxes [874]. Annular flow prevails in the microtubes studied. A prediction of critical quality for saturated flow boiling of CO_2 in horizontal small diameter tubes is presented [875]. Two entrainment mechanisms of interface deformation and bubble bursting are considered in the model. Dryout is determined when the liquid film thickness is less than the critical liquid film thickness. Thermal design methodology is presented for high-heat-flux, single-phase and two-phase microchannel heat sinks [876]. The design model provides assessment of pressure drop in two-phase microchannels, including compressibility, flashing and choking.

The compensated distortion method is extended for modeling CHF in a rectangular inclined channel [877]. A parameter is built by balancing the inertial force acting on the fluid against the viscous effect corrected by a transverse term of gravity. Experimental results are presented that document heat transfer and two-phase flow in inclined tubes [878]. It is shown that dryout takes place in the open annular flow regimes with motionless or slowly moving droplets. Annular upward flow in a narrow annulus with bilateral heating is analyzed with a three-fluid model [879]. The effects of outer wall heat flux on the inner liquid layer are included. The model allows calculation of CHF and critical quality for dryout. Results of high-speed visualization of nucleate boiling in steam–water vertical annular flow are presented [880]. The results demonstrate the interaction between disturbance waves in the liquid film and the activity of nucleation sites. The quench front for reflood heat transfer is modeled with a moving subgrid model [881]. Primary application is the reactor core cooling. The fine mesh moves in the core and follows the quench front as it advances in the core while the rods cool and quench.

The effects of number and angle of microgrooves in the tube wall on the liquid film in horizontal annular, two-phase flow are measured [882]. The grooves act to redistribute the liquid film on the inner wall perimeter. Only a relative small number of grooves are needed. The grooves also affect flow stability. Experimental heat transfer coefficients are presented for evaporation in horizontal tubes with perforated strip-type inserts [883]. The heat transfer performance and pressure drop can be improved up to 2.5 and 1.5, respectively, with the enhanced tube. Augmentation of heat transfer by surface augmentation in a minichannel plate evaporator is measured [884]. Enhancement factors of 2–6 in the heat transfer coefficients are obtained. Experimental results on convective boiling performance inside horizontal microfin and plain tubes are presented [885]. The dominant mechanisms for boiling are shown to change with the size of the tube.

Laser Doppler Velocimetry (LDV) is used to help characterize bubble behavior for pool boiling from two enhanced tubes (one above the other) in saturated R-134a [886]. Heat transfer mechanism and modeling for the upper tube are studied and developed. Performance of a vapotron for application to electronic equipment cooling is documented [887]. A relationship that couples water temperature trends in the cavities with the cycle of events is developed.

The effects of vibration on CHF in a vertical round tube are measured [888]. The CHF enhancement with vibration is more dependent on amplitude than on frequency.

Experiments are conducted on boiling inside a vertical smooth tube for water/lithium bromide mixtures [889]. Average heat transfer coefficients for the mixture increase with a decrease of the solution concentration or with an increase of mass flux. Subcooled flow boiling of ethylene-glycol/water mixtures is measured [890]. Models for pure liquid or saturated flow boiling of mixtures are extended to model subcooled flow boiling of binary mixtures. Heat transfer coefficients are calculated for forced convection boiling of pure refrigerants and binary refrigerant mixtures inside a horizontal tube [891]. Heat transfer coefficients for refrigerant mixtures were lower than linearly interpolated values calculated from the heat transfer coefficients of pure refrigerants. The influence of droplet interchange on evaporation and condensation of multicomponent mixtures in annular flow is commented upon [892].

A turbulence analysis for annular two-phase flow heat transfer enhancement and pressure drop penalty due to the presence of a radial electric field is presented [893]. The radial electric field fluctuation changes the turbulent energy distribution in the flow. A numerical simulation is presented for electric field distributions in ElectroHydroDynamic (EHD) two-phase flow regimes [894]. The results provide a qualitative assessment regarding the direction of phase migration and possible flow pattern transition effected by EHD forces.

A general dynamic model is presented for local heat transfer in bubble columns [895]. Instantaneous local heat transfer rates are measured by using a hot-wire probe in three bubble columns of different diameters. A relation between instantaneous heat transfer and local bubble dynamics is employed.

Modeling of subcooled jet impingement boiling is presented [896]. Heat transfer is shown to be governed by turbulent diffusion caused by the rapid growth and condensation of vapor bubbles. An attempt for ultra-high CHF with jet impingement is documented [897]. The maximum CHF achieved is 212 $\mathrm{MW/m^2}$, or 48% of the theoretical maximum heat flux proposed in the literature. Measurements are presented for heat transfer from a hot plate to a water jet [898]. An analysis of temperature fluctuations in the flow enables some conclusions on boiling mechanisms.

13.6. Two-phase thermohydrodynamic phenomena

The effects of wick fit on boiling incipience in a capillary pumped loop are measured [899]. The superheat needed to initiate boiling is strongly dependent on the quality of the contact between the heating plate and the wick. The heat transfer characteristics and flow patterns of the evaporator section of a looped heat pipe are measured [900]. The results show that the combined effects of evaporation of the thin liquid film, the disturbance caused by pulsation and the secondary flows due to the curvature enhance greatly the heat transfer and the critical heat flux. Capillary evaporation in a microchanneled (grooved) polymer film is measured [901]. The results indicate that when the half-angle of the trapezoidal grooves is fixed, the maximum evaporation heat transfer rate increases with increases in the depth and decreases with the width of the grooves. Mechanisms which affect the damping coefficient of capillary waves due to phase transformation are discussed [902]. To focus on the mechanism of heat transfer across the interface between regions of liquid and vapor, potential flow of incompressible fluid is assumed.

14. Change of phase-condensation

14.1. Modeling and analysis

An asymptotic analysis is presented for the case of laminar film condensation on a thin plate with one side in contact with saturated vapor and the other side at a temperature below the saturation temperature [903]. Expressions for the temperature, condensate film thickness and Nusselt number are derived for different cases of a conjugate heat transfer parameter. Kalman extends a theoretical model for bubble condensation in immiscible liquids to the case of miscible liquids and compares the data with flow visualization [904]. Raman spectroscopic measurements are performed to study the effect of non-condensable gases on direct contact condensation at horizontally stratified steam/water flow [905]. Concentration and temperature profile measurements enable calculation of local heat and mass transfer. A similar study uses the RELAP5/MOD3.2 code along with a non-iterative condensation model to study the effect of non-condensable gases on in-tube steam condensation [906]. Film condensation in a vertical microtube with a thin metal wire on its inner surface is analyzed [907].The effects of wire diameter and contact angle between condensate liquid and channel wall are examined. Another study using a vertical microtube studies Kelvin–Helmholtz instability of the phase-change interface during flow film condensation [908]. Chen and Tan [909] perform a theoretical analysis of bubble formation coupled with phase change at a submerged nozzle. Film condensation of vapor flowing inside a vertical tube and between parallel plates is numerically simulated using a mixing length model for turbulence in the vapor and condensate film [910]. Boundary layer transition in film condensation of pure saturated vapor on a horizontal elliptic tube is predicted numerically [911]. The effects of gravity, shear stress and imposed pressure gradient on condensate film thickness are described. Accurate modeling of the interface shear stress is shown to be important in modeling separated turbulent two-phase flow in an inclined tube under adiabatic and condensing conditions [912]. Solutal Marangoni dropwise condensation of a water–ethanol mixture is observed using high-speed photography and the laser-light extinction method [913].

A new flow-structure-based model is proposed for condensation inside horizontal, plain tubes, including the effects of liquid–vapor interfacial roughness on heat transfer [914] Stephan [915] shows that multicomponent phase equilibrium between extremely thin liquid films and their vapor phase on curved surfaces is strongly affected by long-range van der Waals attraction, leading to a shift in equilibrium composition from the state observed for a planar surface.

14.2. Global geometry

Using an apparatus that can control local heat flows to single micropassages, Baird et al. [916] observe a strong influence of mass flux and local quality on the heat transfer coefficient. The effect of tube diameter was negligible. The effects of Froude number, subcooling temperature and system pressure on mean Nusselt number for turbulent film condensation on a half-oval body are discussed [917]. A similar paper discusses the case of turbulent film condensation on a horizontal elliptic tube [918]. Flattening a round tube while keeping mass flow rate constant is shown to enhance heat transfer and pressure drop [919]. A number of papers present experimental data and correlations for a variety of refrigerants in various configurations-R22 and R407C in a gravity driven regime within a smooth horizontal tube [920], in-tube condensation of a mixture of R134a and ester oil [921], pressure drop and heat transfer measurements in miniature horizontal tubes [922], R410A condensing inside internal grooved horizontal tubes [923], the effects of fin geometry on condensation of R407C in a staggered bubble of finned tubes [924], R-22 and R-410A condensing in flat aluminum multi-channel tubes with or without microfins [925], condensation of R134a in a multiport extruded tube [926], and HFC-134a condensing on a single enhance tube [927].

14.3. Surface effects

Heat transfer enhancement ratios are presented for condensation of steam on a horizontal wire-wrapped tube [928]. Shedd and Newell [929] perform visualization of two-phase flow through microgrooved channels in order to understand the mechanism by which microfins cause heat transfer enhancement. They observe increased wall wetting for a given flow condition, decreasing influence of the grooves with increasing gas velocity, and a rotation redistribution of the liquid film by helical grooves. Ferreira et al. [930] present results of R404A condensation under forced flow conditions in horizontal tubes for three surface preparations: smooth, microfin, and cross-hatched. The effects of fin height and helix angle on condensation inside a herringbone microfin tube are experimentally investigated for five types of herringbone microfins [931]. Wang and Honda [932] compare prediction methods for condensation heat transfer in horizontal microfin tubes with several sets of experimental data.

14.4. EHD

Butrymowicz et al. [933] present a review of recently developed techniques for heat transfer enhancement using passive and active condensate drainage techniques. Brand and Seyed-Yagoobi [934,935] use electrohydrodynamic induction pumping as a flow control mechanism and characterize the effects of voltage, frequency, and film thickness on the pumping behavior and heat transfer. Fluid motion is set up due to applied voltages that cause motion of induced charges which are in turn set up by discontinuities in the electrical conductivity of a fluid, such as that at a vapor–liquid interface.

14.5. Mixtures

Jung et al. [936] study the external condensation heat transfer coefficients of non-azeotropic mixtures of HFC32/HFC134a and HFC134a/HCFC123 and find significant deviations from the ideal values calculated by mole fraction weighting of the heat transfer coefficients of the pure components. A thermal resistance due to a vapor diffusion film is speculated to be responsible. Row-averaged heat transfer coefficients are measured for each row in a trapezoidal finned horizontal tube bundle for pure HFC134a and several compositions of the non-azeotropic binary mixture HFC23/HFC134a [937]. Jin et al. [938] present a model for predicting heat transfer characteristics of binary zeotropic refrigerant mixtures inside horizontal smooth tubes. Both vapor- and liquid-side mass transfers are considered, along with a correction for high mass fluxes. Sami and Comeau [939] point out the importance of accurate mixing rules for evaluating transport properties of mixtures and correct available experimental data for R-507, R404A, R-407C, and R-410A.

15. Change of phase-melting and freezing

In this section freezing and melting problems in the literature are reviewed. The problems are broken into various further subdivisions as noted in the subheadings below.

15.1. Melting and freezing of sphere, cylinders, and slabs

Spherical problems included: a parametric study on ice formation inside a spherical capsule [940]; local heat transfer coefficient at spherical particle melting [941]; and surface heat transfer coefficients to stationary spherical particles for hydrofluidization freezing of individual foods [942]. Furthermore, an improved quasi-steady analysis for solving freezing problems in a plate, a cylinder and a sphere were reported by [943]. In cylindrical geometry a numerical solution of the phase-change problem around a horizontal cylinder in the presence of natural convection in the melt was reported by [944]. In slab or plate geometries work included: an analysis of resonances during microwave thawing of slabs [945]; magnetic field effects upon heat transfer for laminar flow of electrically conducting liquid over a melting slab [946]; and heat and mass transfer characteristics of temperature and concentration combined convection due to a vertical ice plate melting [947].

15.2. Stefan problems, analytical solutions/special solutions

Work in this area included: a parabolic cylindrical Stefan problem for modeling vacuum freeze drying of random solids [948]; a finite difference solution of a one-dimensional Stefan problem with periodic boundary conditions [949]; an exact solution of the problem of gas segregation in the process of crystallization [950]; a similarity solution for peritectic solidification with shrinkage-induced flow [951]; and calculation of heat conduction during phase transformation in a shape memory alloy [952]. Lastly, direct measurement of heat transfer rates and coefficients in freezing processes were reported by use of heat flux sensors [953].

15.3. Ice formation/melting

Investigations included: observations of early-stage frost formation on a cold plate in atmospheric air flow [954]; wind-driven supercooled water film on an icing surface—(I) laminar heat transfer and (II) transition and turbulent heat transfer [955,956] thermal analysis of ice walls built by rapid freeze prototyping [957] and investigation of layer thickness and surface roughness in rapid freeze prototyping [958]. Further work included heat and mass transfer at a cold ice wall exposed to seawater near its freezing point [959]; modeling of ice crystal growth in laminar falling films for the production of pumpable ice slurries [960]; and heat and mass transfer on a cylinder surface in cross-flow under supersaturated frosting conditions [961].

15.4. Melting and melt flows

Work in this area is reported alphabetically by first author as follows: experimental and numerical investigations of the temperature field and melt flow in the induction furnace with cold crucible [962]; turbulent flow dynamics, heat transfer and mass exchange in the melt of induction furnaces [963]; experimental and simulation studies of heat transfer in polymer melts [964]; simulation of the sedimentation of melting solid particles [965] and melting in microgravity [966]. Further work included: physical modeling of the melt flow during large-diameter silicon single crystal growth [967]; combined atomistic-continuum modeling of short-pulse laser melting and disintegration of metal films [968]; natural convection in a liquid-encapsulated molten semiconductor with a steady magnetic field [969]; 3-D numerical simulation of on ground Marangoni flow instabilities in liquid bridges of low Prandtl number fluid [970] and pressure dependent viscosity and dissipative heating in capillary rheometry of polymer melts [971]. In addition, other studies reported suppression of Marangoni convection of silicon melt by a non-contaminating method [972]; influence of local magnetic fields on P-doped Si floating zone melting crystal growth in microgravity [973]; three-dimensional gravity-jitter induced melt flow and solidification in magnetic fields [974], influence of high frequency vibrations on fluid flow and heat transfer in a floating zone [975] and heat transfer across a liquid–solid interface in the absence and presence of acoustic streaming [976]. Lastly, a numerical study for the role of natural convection in the melting of a GaSb/InSb/GaSb sandwich system was reported by [977].

Further work includes progress and perspective of processing glass forming melts in low gravity [978]; numerical study of transient thermal ablation of high-temperature insulation materials [979]; modeling the thermal behavior of solder paste inside reflow ovens [980]; heat flux density and heat transfer coefficient between steel melt and metallic substrates [981] and the effect of subcooling on convective melting of a particle [982]; heat and mass transfer of a convective-stratified flow in a trough type tundish [983]; thermal analysis on planar interface stability in solidification of semi-transparent materials [984]. Additional studies reported on finite element solutions of heat transfer in molten polymer flow in tubes with viscous dissipation [985]; homogenization of temperature field in a steelmaking ladle with gas injection [986]; chemical stratification and solidification in a differentially heated melt [987]; kinetics of convective crystal dissolution and melting, with applications to methane hydrate dissolution and dissociation in seawater [988] and energy balance analysis of ignition over a melting polymer subjected to a high radiation heat flux in a channel cross-flow [989]. Finally two modeling papers predicted multicellular melt flow during natural convection-dominated melting [990] and melting of a wire anode followed by solidification [991].

15.5. Powders, films, emulsions, polymers, and particles in a melt

Investigations reported on non-thermal equilibrium melting of granular packed bed in horizontal forced convection. Part I: experiment [992] and Part II: numerical simulation [993] and mechanisms of selective laser sintering and heat transfer in Ti powder [994].

15.6. Glass technology

One study reported radiative transfer modeling on transient temperature distribution in a semi-transparent glass rod [995].

15.7. Welding

Work in this area is presented alphabetically by last author including the following: a numerical simulation of heat transfer and fluid flow in a double-sided gas-tungsten arc welding process [996]; heat transfer and fluid flow during laser spot welding of 304 stainless steel [997]; in situ observations of weld pool solidification using transparent metal-analog systems [998]; modeling and analysis of metal transfer in gas metal arc welding [999] and active solute effects on surface ripples in electron-beam welding solidification [1000]. In addition, modeling of heat transfer and fluid flow during gas tungsten arc spot welding of low carbon steel [1001] and modeling of turbulent transport in arc welding pools were reported [1002].

15.8. Enclosures

One study attempted to resolve the controversy over tin and gallium melting in a rectangular cavity heated from the side [1003]. Others included: conjugate heat and mass transfer under conditions of motion of a viscous incompressible liquid in an open rectangular cavity and wall melting [1004] and natural convection heat transfer in two-dimensional semi-circular slice pool [1005].

15.9. Energy storage—PCM

The work of investigations in this area are presented alphabetically by last author. Work included: analytical solutions for heat transfer during cyclic melting and freezing of a phase-change material used in electronic or electrical packaging [1006]; shape identification for water–ice interface within the cylindrical capsule in cold storage system by inverse heat transfer method [1007]; numerical simulation for fin effect of a rectangular latent heat storage vessel packed with molten salt under heat release process [1008]; approximate analytical model for solidification in a finite PCM storage with internal fins [1009]; solid/liquid phase change in presence of natural convection as a case study [1010]; and an experimental study on thermal characteristics of lauric acid as a latent heat storage material during melting process [1011].

15.10. Casting, moulding and extrusion

Reports in this area focused on conjugate heat transfer and effects of interfacial heat flux during the solidification process of continuous castings [1012]; skin solidification during high pressure die casting of Al–11Si–2Cu–Fe alloy [1013]; effect of chill thickness and superheat on casting/chill interfacial heat transfer during solidification of aluminium [1014]; experiments to determine the interfacial heat transfer coefficient during casting solidification [1015]; numerical simulation of three-dimensional flow, heat transfer, and solidification of steel in continuous casting mold with an electromagnetic brake [1016] and modeling of infrared heating of a thermoplastic sheet used in thermoforming process [1017]. In addition, a hybrid method for casting process simulation by combining FDM and FEM with a novel data conversion algorithm was reported [1018] and a nonisothermal investigation of cast film formation was presented [1019].

15.11. Mushy zone—dendritic growth and segregation

One study reported that the stability characteristics of the mushy zone is affected by the solid layer below [1020]. Additional studies reported on planar solidification with a mushy zone [1021]; thermosolutal transport and macro segregation during freeze coating of a binary substance on a continuous moving object [1022] and sharp-interface simulation of dendritic growth with convection: benchmarks [1023]. Finally one study reports finite amplitude analysis of convection in rotating mushy layers during the solidification of binary alloys [1024].

15.12. Solidification

Work in this area is reported alphabetically by first author. Reports include studies on turbulent momentum, heat and species transport during binary alloy solidification in a top-cooled rectangular cavity [1025]; three-dimensional double-diffusive convection and macrosegregation during non-equilibrium solidification of binary mixtures [1026]; a combined analytic and numerical method for predicting the solid-layer growth from melt crystallization [1027]; simulation of the microstructure of a thin metal layer quenched from a liquid state [1028]; double-diffusive convection during solidification of a metal analog system (NH_4Cl–H_2O) in a differentially heated cavity [1029]; three-dimensional simulation of freckle formation during binary alloy solidification [1030] and analysis of gap formation at mold–shell interface during solidification of aluminum alloy plate [1031]. Other studies included: phase-field modeling of rapid solidification in small alloy droplets [1032]; solidification of a supercooled liquid in stagnation-point flow [1033]; efficient adaptive phase field simulation of directional solidification of a binary alloy [1034]; nanostructural aspects, free volume and phase constitution of rapidly solidified Nd–Fe–B [1035]; effect of magnetic field on g-jitter induced convection and solute striation during solidification in space [1036]; role of the contact layer between liquid and solid on a solidification process [1037]. the structure of plumes generated in the unidirectional solidification process for a binary system [1038].

Additional reports focused on cellular spacings in unsteady-state directionally solidified Sn–Pb alloys [1039]; heat flow parameters affecting dendrite spacings during unsteady-state solidification of Sn–Pb and Al–Cu alloys [1040]; the columnar to equiaxed transition during solidification of Sn–Pb alloys [1041]; numerical simulation of water solidification phenomenon for ice-on-coil thermal energy storage application [1042]; comparison between numerical simulation and experimental measurement of solute segregation during directional solidification [1043]; nucleation of bubbles on a solidification front [1044]; influence of convection and grain movement on globular equiaxed solidification [1045] and controlling phase interface motion in inverse heat transfer problems with solidification [1046]. A last study reported distinct property effects on rapid solidification of a thin, liquid layer on a substrate subject to self-consistent melting [1047].

15.13. Crystal growth

Work in this area is broken into general, Bridgman and Czochralski crystal growth reports. The general reports included the effect of a periodic movement on the die of the bottom line of the melt/gas meniscus in the case of an edge-defined film-fed growth system [1048]; investigation of ice crystal growth and geometrical characteristics in an edge-defined ice slurry [1049]; numerical analysis of the dissolution process of GaSb into InSb melt under different gravity conditions [977]; effect of wetting of melt against die surface on the edge-defined film-fed growth of oxide crystals [1050]; numerical analysis of double-diffusive convection/solidification under g-jitter/magnetic fields [1051] and solutal convection during growth of alloyed semiconductor crystals in a magnetic field [1052]. Additional work investigated the role of heat transfer and thermal conductivity in the crystallization behavior of polypropylene-containing additives [1053]; modeling of phase boundaries for large industrial FZ silicon crystal growth with the needle-eye technique [1054]; an advanced multi-block method for the multiresolution modeling of EFG silicon tube growth [1055]; modeling of solid layer growth from melt for Taylor bubbles rising in a vertical crystallization tube [1056]; three-dimensional simulation of floating-zone crystal growth of oxide crystals [1057]; and optimization of thermal conditions during crystal growth in a multi-zone resistance furnace [1058].

Bridgman work included investigation of the effects of internal radiation on heat flow and facet formation in Bridgman growth of YAG crystals [1059] and on the kinetics and heat transfer of CdZnTe Bridgman growth without wall contact [1060].

Czochralski work represented the bulk of the crystal growth literature reviewed. Investigations included the prediction of the melt/crystal interface geometry in liquid encapsulated Czochralski growth of InP bulk crystals [1061]; effect of internal radiative heat transfer on spoke pattern on oxide melt surface in Czochralski crystal growth [1062]; effect of RF coil position on spoke pattern on oxide melt surface in Czochralski crystal growth [1063]; mechanism of heat and oxygen transfer under electromagnetic CZ crystal growth with cusp-shaped magnetic fields [1064]; gas flow effect on global heat transport and melt convection in Czochralski silicon growth [1065]; calculation of bulk defects in CZ Si growth: impact of melt turbulent fluctuations [1066]; effect of thermocapillary convection in an industrial Czochralski crucible [1067]; transient and quasi-stationary simulation of heat and mass transfer in Czochralski silicon crystal growth [1068]; modeling analysis of VCz growth of GaAs bulk crystals using 3-D unsteady melt flow simulations [1069]; modeling analysis of liquid encapsulated Czochralski growth of GaAs and InP crystals [1070]; global heat and mass transfer in vapor pressure controlled Czochralski growth of GaAs crystals [1071] and variations of solid–liquid interface in the BGO low thermal gradients Cz growth for diffuse and specular crystal side surface [1072]. Final studies included numerical analysis of transport phenomena in Y–Ba–Cu–O melt during growth of superconducting crystal Y123 by Czochralski method [1073] and influence of internal radiation on the heat transfer during growth of YAG single crystals by the Czochralski method [1074].

15.14. Droplets, spray, and splat cooling

Work in this area is reported alphabetically by first author. Investigations included work quantifying interfacial thermal resistance and surface energy during molten microdroplet surface deposition [1075]; Marangoni and variable viscosity phenomena in picoliter size solder droplet deposition [1076]; droplet solidification and gas-droplet thermal coupling in the atomization of a Cu–6Sn alloy [1077]; a stochastic model to simulate the formation of a thermal spray coating [1078]; experimental investigation of the transient impact fluid dynamics and solidification of a molten microdroplet pile-up [1079]; experimental and numerical analysis of the temperature transition of a suspended freezing water droplet [1080]; modeling thermal spray coating processes: a powerful tool in design and optimization [1081]; synthesis of β-$FeSi_2$ by splat solidification in short-duration microgravity [1082]. Additional work focused on coupled liquid film and solidified layer growth with impinging supercooled droplets and Joule heating [1083]; Eulerian three-phase formulation with coupled droplet flow and multimode heat transfer [1084] and temperature gradient in the unfrozen liquid layer for multiphase energy balance with incoming droplets [1085]; heat flow and solidification during atomization and spray deposition processing [1086] and modeling and simulation of the microstructure evolution of the gas-atomized alloy droplets during spray forming [1087]. Final studies included an experimental study and modeling of the crystallization of a water droplet [1088] and interactions between molten metal droplets impinging on a solid surface [1089].

15.15. Oceanic, geological, and astronomical phase change

Work in this area focused on melt generation and fluid flow in the thermal aureole of the Bushveld Complex [1090] and the contribution of mantle plumes, crystal thickening and greenstone blanketing to the 2.75–2.65 Ga global crisis [1091].

16. Radiation

The papers below are divided into subcategories that focus on the different impacts of radiation. Most of the papers report the results of modeling studies. Papers describing the development of new numerical methods themselves are reviewed in the numerical methods section under the subcategory radiation.

16.1. Radiative transfer calculations and influence of the geometry

Several methods have been used to study radiative transfer in one- or multi-dimensional systems. The Discrete Ordinate Method (DOM) is popular among many authors. Koo et al. [1092] apply it to two-dimensional curved geometries. Li et al. [1093] consider collimated irradiation and attempt to mitigate ray effects [1094]. A discrete ordinate scheme is also used to model 2-D pinhole image formation of large-scale furnaces [1095]. Vargas et al. [1096] propose a decomposition method for slab geometries. The discrete transfer method is used to estimate boundary conditions [1097]. An adaptive angular quadrature for the discrete transfer method based on error estimation is discussed in [1098]. Angular domain discrete wavelets are used to analyze the radiation in rectangular domains [1099].

Daun et al. [1100] propose a geometric optimization for radiant enclosures with specular surfaces. A backward Monte Carlo method is discussed in [1101]. Finite volume methods are used for one-dimensional transient transfer [1102], in complex geometries with different boundary treatments [1103], and for the analysis of partitioned idealized furnaces [1104]. Park and Sung [1105] describe a three-dimensional inverse radiation problem. Nonlinear programming is used to optimize radiative enclosures in [1106]. Highly efficient parallel computing schemes are developed in [1107,1108]. A fast approximate method for radiative exchange based on view factors is proposed for use in combined heat transfer calculations in [1109].

A reduced integration scheme is proposed by Tian and Chiu [1110]. Song and Li report an adaptive integration scheme for thermal radiation exchange in axis-symmetric furnaces [1111]. A half-space moment method is applied in [1112]. The inverse evaluation of an emissivity function is presented in [1113]. The use of extended surfaces for the reduction of critical temperatures of theater luminaries is discussed in [1114]. The thermal response of plasma facing components in a steady-state tokamak is studied analytically and via a 2-D finite element model in [1115].

16.2. Radiation and combustion

Combustion problems involve radiative heat transfer as well as participating media, and other heat transfer modes.

A number of papers consider radiation in flames. Zheng et al. [1116,1117] study the spectral radiation properties of partially premixed and non-premixed flames. The influence of the initial droplet size on the burning rate is studied in [1118]. Radiative transfer and its influence on the soot formation in a jet diffusion flame is discussed in [1119]; spectral radiative effects and turbulence/radiation interaction in a non-luminous turbulent diffusion flame are considered in [1120]. A weighted sum of gray gases model is used in the modeling of opposed flow diffusion and partially premixed flames [1121]. Turbulence/radiation interactions in diffusion jet flames are studied in [1122].

Aspects studied related to the radiative heat transfer and its influence on fire spread include the interaction of the fire environment and internal solid regions [1123], radiation in bushfires [1124], and the dynamics of flashover in compartment fires [1125]. Also relevant for this topic is the evaluation of the Planck mean absorption coefficient for radiation transport through smoke [1126]. The use of the gray assumption in fire/water spray assumptions is investigated in [1127]. Radiation in non-gray sooting media is studied in [1128].

Wiedenhoefer and Reitz present a multi-dimensional radiation model for diesel engines [1129]. A fast correlated-k approach is proposed in [1130]. The multi-dimensional characteristics of sodium combustion are studied in [1131].

16.3. Participating media

Papers in this category focus on emission and absorption properties, as well as scattering properties of the participating medium.

Several papers deal with the efficient description of radiative transfer in participating gaseous media. Zhang and Modest consider the radiative properties of CO_2 and water vapor [1132–1134]. Modest [1135] compares the correlated-k vs. scaling approximation for narrow-band and full-spectrum distributions. A multi-band model is used in the simulation of a hypersonic radiating flow field [1136].

Semitransparent media featuring absorption and emission and sometimes spatially non-uniform refraction are studied in several papers. Graded index semi-transparent slabs are considered in [1137], refractive index effects in multilayer scattering composites in [1138,1139], and semi-transparent slabs with arbitrary refractive index distributions in [1140,1141]. Transient heat transfer in a multilayer composite with one specular boundary is studied in [1142]. Zhou and Zhang consider semi-transparent silicon wafers with rough surfaces [1143]. Absorption considering a large number of frequency bands is studied in the cooling of high quality optical glass [1144]. A new domain isolation approach is described in [1145] and applied to large-scale semi-transparent media.

Isotropic scattering is important in several participating media. Two approximation schemes for 1D slabs are discussed in [1146]. A plane parallel random medium of two immiscible media with Rayleigh scattering is considered in [1147]. Homogeneous and inhomogeneous solid spherical media are considered in [1148].

Several papers also deal with the influence of anisotropic scattering. Hao et al. [1149] study the effect of anisotropic scattering on the radiative transport in two-dimensional rectangular media. The discrete ordinate method in anisotropic scattering problems is studied in [1150,1151]. Radiative transfer in three-dimensional cylindrical media is investigated in [1152]. The existence and uniqueness of a steady-state solution of a coupled radiative–conductive problem for a non-gray anisotropic medium is studied in [1153].

Various papers focus on numerical approaches to model participating media. An inverse radiation problem is solved in [1154] by minimizing a performance function defined by the square residuals of calculated and observed temperatures. An inverse boundary design problem for a participating medium with irregular boundaries is solved in [1155]. A net radiation method is applied to the exchange between two gray plates through a radiation shield of transparent/reflecting/absorbing plates [1156].

16.4. Combined heat transfer

Papers in this subcategory consider the combined effect of radiation with conduction and/or convection. Several papers focus on conduction and radiation. A complex combination solution for radiative–conductive transfer with periodic boundary conditions is developed in [1157]. Nonlinear heat transfer in a conductive/radiative system consisting of a thin finite rod is studied in [1158]. The collapsed dimensions method and discrete transfer method for combined heat transfer are compared in [1159]. An inverse boundary design problem for irregular two-dimensional domains is considered in [1160]; a slab is considered in [1161]. Transient conduction/radiation in planar packed beds with variable porosity is studied in [1162]. A radial effective thermal conductivity including the effect of radiation has been defined for steel coils in a HPH furnace in [1163].

Convection and radiation plays an important role in film cooled liquid rocket engines [1164]. Sparrow and Abraham [1165] present a computational analysis of radiative and convective processes in preheated and non-preheated ovens. Radiation combined with laminar mixed convection in vertical tubes is considered in [1166]. Adomian's decomposition procedure is applied to convective–radiative fins in [1167]; mutually irradiating fins are investigated in [1168]. A shape optimal design of gray radiative bodies exposed to forced convection is performed in [1169].

Radiation, convection and conduction play a role in the modeling of moving bed furnaces for uranium tetrafluoride production [1170], and in the modeling of thermophotovoltaic systems [1171].

16.5. Microscale radiative transfer

Transmission enhancement by negative–refractive index layers was studied by Fu and Zhang [1172]. The influence of adsorbates on the heat transfer between two solid surfaces at short separation was investigated by Volokitin and Persson [1173]. Transient radiative transfer through thin films is the topic of Hassan et al.'s work [1174]. A rigorous electromagnetic model of the radiative properties of a patterned silicon wafer is developed in [1175].

A number of papers by Liu consider the interaction of radiation with small particles. The effect of multiple size groups is studied in [1176], the impact of locally non-uniform particle temperatures are studied in [1177], and a concept for multi-scale modeling of polydispersions is discussed in [1178]. The radiative transfer in electro-controllable fluids which contain micron-sized, polarizable particles is investigated by Hargrove et al. [1179]. The radiative properties of construction materials based on dispersed particulate media are analyzed in [1180].

16.6. Experimental methods and systems

Only few studies of experimental methods and systems are reported this year. Sanchez and Sutton determine the reflectance function of aluminum and stainless-steel foil surfaces with an experimental scatterometer [1181].

17. Numerical methods

Advances in numerical methods and the easy availability of the necessary computer hardware have led to widespread simulation of physical processes on a computer. The simulation of heat transfer, fluid flow, and related processes is achieved by numerical solution of the governing partial differential equations. The numerical simulation is used in academic research and in industrial applications. In this review, the papers that mainly focus on the application of numerical methods to particular problems are reviewed in the appropriate application category. The papers that primarily deal with the development of a numerical technique are included in this section.

17.1. Heat conduction (direct problems)

Laplace transforms are used to calculate transient heat flow through multilayer spherical structures [1182]. Parallel computations are performed for lower and upper bounds of temperature in a conjugate heat transfer problem [1183]. A domain decomposition method is described for three-dimensional boundary-element models in heat conduction [1184]. A perturbation technique is presented for conjugate heat transfer in circular ducts [1185]. A second-order finite-volume procedure is proposed for anisotropic media [1186]. Adaptive Delaunay triangulation is used for heat conduction analysis [1187].

17.2. Heat conduction (inverse problems)

A network simulation method is used for an inverse determination of unsteady heat fluxes [1182]. The performance of an inverse heat conduction method is studied for the identification of shape of a solid body [1188]. A simplified conjugate-gradient method is employed for shape identification [1007]. A method is formulated for multi-dimensional inverse heat conduction problems [1189]. An iterative regularization method based on an inverse algorithm is applied for the simultaneous determination of heat and mass production rates [1190]. A direct integration approach is used for the inverse determination of thermal conductivity and specific heat [1191]. Thermophysical properties are also estimated for an anisotropic composite material [1192]. An inverse heat conduction problem in nanoscale is solved using a sequential method [1193]. Non-iterative determination of thermal conductivity is made by a direct integration method [1194]. A solution method is described for a nonlinear three-dimensional inverse heat conduction problem [1195]. A solution scheme based on the maximum entropy method is presented for a two-dimensional heat conduction problem [1196]. In turbulent forced convection, the wall heat flux is estimated by inverse analysis [1197]. A non-iterative finite-element method is described for inverse heat conduction problems [1198]. A transient inverse heat conduction problem is solved in the context of gas quenching of steel plates [1199]. A sequential method is proposed for the estimation of boundary conditions in nonlinear inverse heat conduction problems [1200].

17.3. Phase change

An implicit enthalpy formulation is proposed for phase-change problems on an unstructured grid [1201]. Perturbation methods are developed for Stefan problems with time-dependent boundary conditions [1202]. Benchmark cases are presented for the solution of one-dimensional Stefan problems [1203]. A fixed-grid front-tracking algorithm for solidification is described [1204] and applied to the problem of directional solidification [1205].

17.4. Convection and diffusion

A new stabilized formulation is presented for the convection-diffusion problem [1206]. A study is presented for the use of linear feedback control for convection and diffusion [1207]. A variety of TVD schemes are implemented for unstructured grids and their performance is examined [1208]. An improved advection scheme is used for the treatment of buoyancy [1209]. A streamline upwind numerical formulation is used for simulation of confined impinging jets [1210].

17.5. Fluid flow

A node-centered pressure-based method is proposed for all speed flows on unstructured grids [1211]. The momentum interpolation method is studied for flows with a large body force [1212]. A general pressure-correction strategy is described for the inclusion of density variation in incompressible algorithms [1213]. An algebraic smoothing pressure correction is employed for preventing pressure checkerboarding on meshes with collocated variables [1214]. A higher-order mixed finite-element method is used to solve a natural convection benchmark problem [1215]. Four outflow boundary conditions are investigated for use with multidomain spectral method [1216]. A multiblock implementation of a single-block flow solution procedure is reported [1217]. A scalable finite-element solution of the Navier–Stokes equations is developed [1218]. A time-accurate finite-element algorithm is presented for incompressible flows [1219]. An efficient artificial-compressibility scheme is introduced for finite-element solution of incompressible flows [1220]. A pressure-stabilization technique is presented for an equal-order finite-element algorithm [1221]. An improved SIMPLEC method is formulated for collocated grids [1222]. A finite-difference method for the Navier–Stokes equations is implemented on non-staggered grids [1223]. A new higher-order bounded scheme is proposed for incompressible flows [1224].

17.6. Other studies

A parallel unstructured-grid finite-volume method is developed for turbulent flames using the flamelet model [1225]. A method of creating dynamically adapting grids is presented for unstable laminar combustion [1226].

18. Properties

Thermal conductivity and diffusivity attract an unusually high level of interest. Biological and nanosystems are the focus of property investigations, analytical and experimental.

18.1. Thermal conductivity, diffusivity, and effusivity

Experimental investigations include the thermal conductivity of Kapton HN sheets at super fluid helium temperatures, the use of a novel cylindrical hot wire probe to determine the conductivity of biological tissue, and the determination of the role of moisture in the insulation effectiveness of certain insulations and building materials [1227–1229]. A variety of techniques are employed to measure the diffusivity of disparate systems: photo-acoustic scheme for undoped Bi_2Se_3 crystals doped with various concentrations of Te; photo-thermal radiometry technique to improve the measurement accuracy; a dual-thermistor probe using the heat pulse method for absolute measurement of diffusivity and conductivity, the transient plane source (TPS) technique for measuring effective diffusivity and conductivity for polyaniline (PANI) mixed with manganese and iron and high T-C superconductors at low temperatures. Photothermal displacement spectroscopy for a non-contact approach for obtaining diffusivity values for solid systems; the laser flash and hot-wire methods are applied to determine the effect of structure on the diffusivities of liquid silicates. A new photo-pyroelectric approach is described for measuring thermal effusivity in three transparent liquids [1230–1238].

A number of papers report conductivity results for novel systems: enhancement of conductivity using heat transfer fluids with suspended ultra-fine particles of nanometer size (nanofluids); a microdevice for measuring thermophysical properties of one-dimensional nanostructure (nanotubes, nanowires, nanobelts); for solid SF_6, $CHCl_3$, C_6H_6, CCl_4 crystals the contributions of phonon–phonon and phonon-rotation interactions to total thermal resistance are identified; measurement of phonon diffusivity of glass and silica aid the thermal characterization of semi-transparent media; using the laser-flash technique the conductivity of small-grained porous ceramics and large-grained dense ceramics are measured; experiment justifies a need to account for internal thermal radiation heat transfer in establishing the effective thermal conductivity for burning black-liquor particles; measurement of thermal diffusivities for single crystals and mantel rocks improve the understanding of the heat transfer process in mantle dynamics geology [1239–1245]. Thin film properties are studied using photo-thermal beam deflection technique for thermal diffusivity of Bi_2Se_3, the molecular beam method for double epitaxial layers of doped n-type GaAs, and an open photoacoustic cell to evaluate thermal diffusivity of intrinsic and doped InP. Thin film conductivity, important in the design of nano-electro-mechanical or micro-electro-mechanical systems, is calculated using non-equilibrium molecular dynamics [1246–1249].

18.2. Diffusion

The role of diffusion is studied for a variety or systems: acetone, methyl acetate, and chloroform in amorphous polyvinylacetate using solvent evaporation and transient effects of disturbances on self-diffusivity measurements. The process of diffusion is also important in a number of applications: absorption by thin disks when immersed in certain liquids with consequent swelling; diffusive properties of methanogenic granular sludge in wastewater treatment bioreactors, thermal diffusivity measurements for seven upper mantle rocks, and an experiment based correction proposed for the mass diffusivity or wood in steady regime [1250–1255].

18.3. Heat capacity/specific heat

Experimental measurements are reported for: solids at room temperature by measuring the cooling (or heating) rate of a sample; reaction mixtures using a small scale (100 mL) calorimeter; protein model compounds, as affected by added protein denaturant (Urea), using a vibrating tube densimeter and a dynamic microcalorimeter; softwood bark and softwood char particles and agricultural materials (cottonseed and co-products) [282,1256–1259] using differential scanning calorimetry.

Analytical investigations embrace a variety of systems and approaches. Thus microwaves accelerate the curing process of polymer and polymer based composites, particularly electrically conductive adhesive (ECA) and cause internal heat generation and conduction. Finite element analysis estimates the transverse thermal conductivity of continuous fiber reinforced composites of random distribution and imperfect interfaces. Using non-equilibrium molecular dynamics (NEMD) the effect of molecular elongation on the conductivity of diatomic liquids has been analyzed. For the normal modes of the protein myoglobin, thermal conductivity and diffusivity are calculated using perturbation theory. Dense gases and liquids conductivity dependences on concentration are considered within the framework of the lattice model. For the non-uniform granular system a fractal model is found to study the effective thermal conductivity of the mixed system. A novel percolation computational model is introduced to analyze likely future integrated circuits employing polymers filled with highly conductive ceramic (e.g. boron nitride) particles to promote high thermal conductivity. A similar system of mixed granular material (e.g. quartz sand bonded in resin common to metallic alloy casting) achieves practical results by using a substitute thermal conductivity coefficient. Heat transfer in high porosity foods is also modeled using an apparent conductivity, and also by an artificial neutral network (ANN). For predicting soil temperature profiles in land surface models a scheme is developed based on the discretized diffusion equation of Heat Transfer through the soil column [1260–1272].

Heat capacity effects are examined when calculating phase-change thermodynamic properties for water, 1-butanol, and *n*-octave liquid phases and a helium vapor phase. A simple quantitative structure–property relationship is used to calculate a set of properties or aliphatic alcohols. Thermal (and magnetic) properties for strong coupling ladder compounds are investigated by the quantum transfer matrix method [1273–1275]. For nanosystems thermal conductivity is investigated for a semiconductor nanowire and for nonafluids formed by suspending metallic nanoparticles in conventional base liquids [1276,1277]. Models are also developed for calculating state properties for refrigerant mixtures of R507 and R410A and formulating thermodynamic properties of supersaturated moist air [1278,1279].

18.4. Viscosity

The utility of equations used to compute the viscosity of neutral and ionized species and gas mixtures is assessed and the practice of correcting for the exponential dependence of viscosity on temperature in natural convection is given a mathematical basis [1280,1281].

19. Heat transfer applications—heat exchangers and thermosyphons

19.1. Heat exchangers

A major effort is directed toward the design, modeling, numerical analysis, and correlation of existing data on heat exchangers. Design is the focus for a honeycombed rotary desiccant wheel, plate heat exchangers, non-circular duct passages, a divided circular conduit, and two-phase exchangers [1282–1286]. Modeling embraces plate exchangers of generalized configuration, natural circular loop thermal convection, counter-flow wet cooling towers, fluidized-bed exchangers, high performance cryogenic units, power transformers, black-liquor evaporators, thin porous layer devices, and a vapor-compression machine using R-407C [1287–1297]. Numerical analysis treats rectangular channels with built-in circular tube, effect of inlet flow on performance of 3-fluid cross-flow exchanger, efficiency of concentric circular tubes, entropy generation in exchangers, effectiveness-NTU equations, LMTD for exchangers, imaging local coefficients in plate-finned tube units, combustor-exchangers, thermoelectric generation in condensers, coil energy recovery loop system and refrigeration devices [1298–1311]. Correlations include coefficients in a helical tube unit, membrane dialysis in rectangular mass devices, unified Wilson plot approach, simulation of air separation unit exchangers, and exchanger transient analysis [1312–1316].

Experimental works consider a variety of systems and situations: thermal contact resistance in fin-and-tube evaporators, evaporation of R410A in plate exchanger, circulating fluidized bed evaporation, scraped surface exchanger, condensation of steam and non-condensable gas in tubes, an improved method of measurement data reduction, 3-D woven mesh exchanger surfaces, flow of foam in staggered tube bank, natural draft cooling towers, and absorption of organic fluid mixtures in plate exchangers [1317–1329].

A number of investigations study refrigeration and climate control areas: a small capacity shell and tube ammonia evaporator refrigerant flow in capillary tubes, wire-and-tube condensers, switching frequency in adsorption chillers, survey of refrigerant plate evaporators, air-conditioning rotary regenerator, effect of compressor oil on system exchangers, the Gifford–McMahon-type pulse tube refrigerator, window steam condenser, low temperature waste heat adsorption chiller, hollow fiber membranes for evaporative cooling, optimization of regenerated air refrigerator and the analysis of reversed cooling tower operation [1330–1343].

Other papers consider heat-exchanger networks [1344–1347], compact exchangers [1348–1350], vertical bore and earth-air exchangers [1351–1354], and falling film heat transfer in a desalination system [1355]. Metal foams as compact high performance exchangers, reducing micro reactor/size by enhancing heat transfer, thermal microflow sensors, and microchannel cooling of microprocessors conclude this section [1356–1359].

19.2. Heat transfer enhancement

A variety of approaches, some simple and straight forward, others novel or complex, are explored to enhance heat transfer. Analytical studies include the insertion of an impermeable surface of negligible thermal resistance to divide a circular tube into two sub channels, the use of longitudinal vortices, perforated plate matrix exchangers (MHES), regenerators with spherical particles, fluted tube-in-tube condensers in heat pumps, cylinder with high conductivity radial fins in cross-flow, absorption refrigeration with finned exchanger, plate exchanger with rectangular winglet pair combining vortex and lower fin effects, surface-mounted block heat sources in a duct with baffles, pin-fin exchanger in unsteady flow, air-cooled finned exchanger with thin water film evaporation, radiating and convective-radiating circular fin design, fin-tube junction effects in flat tube louvered exchangers, and use of oval tubes and multiple delta winglets in cross-flow exchangers [1360–1374].

Experiments are conducted on: angled spiraling tape inserts in an exchanger annulus, louvered-fin arrays, clamshell exchangers with dimples, condensation in plate exchangers with various chevron angles, plain and finned tube evaporatively cooled exchangers, corrugated channel exchanger, plate heat exchangers (PHES) with wavy channels, channels fully or partly filled with porous medium, tip clearance effects on shrouded pin-fin array performance, miniature loop heat pipes for electronics cooling, subcooled–scraped surface with/without phase change, rectangular ducts with staggered square pin fins, loss penalty for tube row numbers in staggered finned-tube bundles with winglets, convective transfer from extruded helical finned tubes, airside transfer of finned tube bundles, enhancing transfer using drag reducing surfactant solutions, rectangular channels with porous baffles, microfin array with flow-induced vibration, condensation in narrow rectangular channels with perforated fins, finned tube exchanger operation under frosting conditions, two novel two-phase heat transfer fluids-microcapsule slurry and emulsion-enhance process, and fin-and-tube-exchangers with radial slit fins [1375–1395]. Naphthalene sublimation technique is applied to louvered-fin arrays, a plate fin and two-tube assembly, winglet vortex generator height and 3-row flat tube bank fin, and the behavior of a vortex-enhanced interrupted fin [1376,1396–1398].

19.3. Fouling

Since the fouling of heat exchangers can significantly influence the performance of a plant and its elements efforts continue to understand, prevent or mitigate the phenomeum. This has led to the study of the mechanism of crystallization, modifying the interfacial interaction between the surface and crystalline deposit, simulating the fouling process using the CFD code FLUENT, the effects of changes in solution composition in seawater evaporators, oxide depositions on Incoloy 800 steam generator tubes, prediction of depositions on HVAC exchanger with particles present [1399–1406].

Experiments treat water scale influence on circumferential tube heat transfer in staggered tube bank, effect of alkaline-acidic cleaning solutions on fouling of heat transfer surfaces in milk pasteurization, air side fouling in a compact exchanger, internal helical-rib roughness tube fouling, reduction of bio-fouling through biofiltration of process water, non-binding oil shale ash deposition on boiler transfer surfaces, fouling and cleaning effects on enhanced exchanger surfaces, tube thermal stresses arising from cleaning jets, initiation growth and composition of crystals formed from Na_2CO_3 and Na_2SO_4, and fouling tendencies of pulverized–blended coals, and mitigation of fouling by ozonation [1407–1417].

19.4. Thermosyphons (heat-pipes)

Design, models, numerical analysis, and simulation are treated for a number of heat-pipe applications. Included are: oscillatory flow in pulsating devices, mathematical model for heat sink embedded with closed two-phase thermosyphon, high-speed rotating units, steady-state operation of salt loaded heat-pipes, two-dimensional model of sintered porous media heat transfer, stability boundaries in natural circulation single-phase loop, operation limits for rotating cylindrical units, start up lithium–molybdenum device from frozen state, and the influence of electric field presence [1418–1426]. Special consideration is given to heat pipe use in electronic cooling, miniature compact two-phase thermosyphons, electro hydrodynamic micro heat pipes, and mantle convection in terrestrial bodies. The status of research, development and application of this technology in China is also reported [1427–1433].

Measurements on the behavior of such systems consider flat and U-shaped heat spreaders for high power electronics, effects of air infiltration on large flat-plate units, boiling and two-phase closed units with internal grooves, closed loop pulsating and oscillating devices, smooth-wall reciprocating anti-gravity open systems, influence of inclination angle on condensation for closed two-phase units, radially rotating heat pipes, transient behavior of two-phased closed version, aspects of sintered microfibrous metallic felts applied to heat pipes, thermosyphon use in thermoelectric refrigeration system, gas-controlled heat pipe use for accurate temperature measurements, small-loop configurations, and micro heat pipes for electronic cooling [1434–1449].

20. Heat transfer applications: general

20.1. Nuclear reactors

Several papers analyze hypothetical loss-of-coolant-accident (LOCA) situations. Heat transfer in the narrow gap between molten core debris and the reactor pressure vessel have been studied by Okano [1450]. Martin-Fuertes et al. [1451] study two reactor flooding scenarios when the molten core (corium) relocates to the lower-plenum region of the reactor. Maruyama et al. [1452] perform calculations to evaluate the effectiveness of cooling reactor debris in a LOCA by water injection. The transient temperature field in a fusion–fission International Thermonuclear Experimental Reactor (ITER) under a LOCA is studied, and time required for structural failure is evaluated [1453].

Han and Chang [1454] develop a thermohydraulic analysis code which can model internally and externally cooled fuel pins, and compare its results to other codes such as RELAP.

Peterson et al. [1455] evaluate the RETRAN3D code by comparing two-phase pressure drop and heat transfer predictions to a large body of experimental data.

20.2. Buildings

Usmani et al. [1456] perform a finite-element analysis of the collapse of the World Trade Center towers and argue that the fires created by the attack may alone have been responsible for building collapse, even if there had been no structural failure. Ludwig [1457] presents different models heat transfer processes that are used to reduce data obtained from thermographic testing of buildings, and shows how accurate data may be obtained in spite of complicating variables. The impact of mixed convection on the cooling capacity of a ceiling radiant panel in mechanically ventilated spaces is estimated [568]. The influence of assembly method on the heat transfer in a wall of vertically perforated bricks is estimated [1458]. Garrabrants and Kosson [1459] model moisture transport from a Portland cement-base material during storage in reactive and inert atmospheres. Goering [1460] studies the heat transfer and thermal characteristics of railway embankments that are made of unconventional materials to prevent thawing in permafrost covered areas. Three different kinds of such embankments are studied for the case of the Qing-Tibet railway [1461]. Hagishima and Tanimoto [1462] perform measurements of the convective heat transfer coefficient for various urban canopy surfaces. An inverse method to calculate transient convective heat transfer coefficients inside building enclosures is evaluated experimentally [1463].

20.3. Geophysics

Zhao et al. [1464] investigate the effects of hot intrusions and topographically driven horizontal flow on the distributions of pore velocity and temperature in large-scale hydrothermal systems. Santoyo et al. [1465] explain the difference between measured and predicted convective heat transfer coefficients in drilling of geothermal wells by accounting for non-Newtonian effects. Inoue et al. [1466] measure turbulent heat fluxes over the Sea of Okhotsk during cold-air outbreaks and find that the primary contribution to the heat flux is the ice concentration on the surface. Golden [1467] applies percolation theory to sea ice, and discusses how the geometry and connectivity of brine microstructure in ice determine its complex permittivity and transport of nutrients in sea ice. Simulation of the thermal and hydraulic field because of a negative temperature gradient and cold temperatures in the 1-kn-deep borehole of the Mauna

Kea (Hawaii) suggests that meteoric water flow from the mountain range controls the temperature in the upper part of the borehole, while salt water circulation from the nearby ocean affects the lower part [1468].

20.4. Electronic packaging

Ryu and Choi [1469] perform shape optimization for the thermal performance of a manifold microchannel heat sink using a SIMPLE-type finite volume method for the flow equations and a steepest-descent technique for shape. Another study uses an inverse method to optimize the shape of a package containing multiple heating elements, with the constraint of a specified outer surface temperature [1470]. Darabi and Ekula [1471] present a novel device for chip cooling which uses electrohydrodynamic principles. A thin electric field is applied using a set of interdigitated inclined electrodes to form a thin film of fluid over a surface requiring cooling. An equivalent thermal conductivity model for heat sinks based on the Churchill and Chu correlation is presented [1472]. Ghodoosi and Egrican [1473] use constructal theory for solving a conductive cooling problem. Active thermal control is applied to distributed parameter systems such as packaged devices such as microprocessors [1474]. The effects of local flow phenomena such as stagnation and acceleration, separation and reattachment of the cooling flow on the local heat transfer coefficient are studied using a mass transfer (naphthalene sublimation) experiment [1475]. Coetzer and Visser [1476] present a compact model to predict interfin velocity and resulting pressure drop across a longitudinal fin heat sink with tip bypass.

20.5. Manufacturing and processing

20.5.1. Milling

Chen et al. [1477] present an inverse heat transfer model to calculate heat flux and temperature distribution on the tool–workpiece interface in high-speed milling.

The heat transfer coefficient during the thermoplastic composite layup process is estimated using an inverse method [1478]. Eulerian and Lagrangian approaches are compared for transient heat transfer analysis of simultaneous tape winding and in situ curing of orthotropic composites [1479].

20.5.2. Casting

Models are developed and experimentally validated for the non-isothermal filling of the mold during a resin transfer molding process [1480]. Glass forming is analyzed and the effects of radiative heat transfer on the glass–mould contact temperature are quantified [1481]. Glass composition is identified as a significant parameter. A fixed-mesh finite element formulation is used to solve the weak form of the Navier–Stokes equations to simulate a twin-roll strip casting process [1482]. A finite element model is developed and its results compared with experimental data on squeeze casting of metal matrix composites in cylindrical molds [1483]. The effect of gas pressure of evaporated foam on the molten flow and free surface behavior during the lost foam casting process is simulated using the SOLA-VOF algorithm [1484]. The Downhill Simplex and Beck's optimization method are used to calculate the thermal contact resistance between an alloy casting and a mold, and the heat transfer coefficient between the mold a bath used to control the speed of the solidification process [1485].

20.5.3. Welding

A heat transfer model for deep penetration laser welding is presented that examines an experimentally obtained stable keyhole. The temperature around the keyhole and the heat flux lost to the keyhole walls are estimated [1486]. Analysis of spot welding using conduction heat transfer alone seems sufficient to estimate transition to keyhole formation, if the 'double-ellipsoidal' representation of the laser beam is used [1487].

Shiff [1488] considers the problem of determination of volumetric heat generation in a furnace chamber from the observed radiation flux distribution. A mathematical model of a mineral melting cupola furnace for stone wool production including the effects of reactions between coke, iron oxide, limestone and gaseous species is presented [1489].

The development of a model to describe conditions during hot-pressing of wood-based composites is discussed and the effects of air, water and vapor content, temperature and cure index are quantified [1490].

The heat transfer coefficient on the surface of a billet cooled by an obliquely impinging gas jet formed by a circular array of 24 jets within a single nozzle was studied experimentally [1491]. The results of simulations of high-pressure water-jet assisted orthogonal metal cutting, in which water is injected into the work–tool interface indicate a reduction in temperature, cutting force and residual stresses in the tool as a result of the pressure applied by water [1492]. An analysis of flow and heat transfer from a heated flat surface moving continuously in a parallel freestream of non-Newtonian fluid is performed for a power-law temperature profile and three common thermal boundary conditions [1493].

20.6. Food processing

Heat transfer during vacuum cooling of foods is simulated and the effects of water content, thermal shrinkage and anisotropy of the food are determined [1494]. Simulations of transient heat and mass transfer in porous cooked meat joints during vacuum cooling show that the effects of weight, shape, and size of meat joints on the cooling rate and percentage weight loss are negligible, while the porosity and average pore size have a significant effect on the pressure distribution in the meat [1495]. Another model for vacuum cooling discusses the effects of thermophysical properties, convection heat transfer, latent heat of evaporation as well as vacuum cooling parameters on heat and mass transfer from food [1496].

Conjugate heat transfer in a freezer due to food freezing is modeled [1497]. A transient simulation of heat and mass transfer in bulks of chicory roots is conducted using a porous media model and an Ergun-type equation based on experimental data [1498]. From experiments on cylindrical dough samples, Fu et al. [1499] find that a first-order kinetic model adequately predicts moisture migration in solid food matrices. Freezing times are estimated for various products by modeling the process as a parabolic equation that incorporates the behavior of the three distinct regions (solid, liquid and interface) that exist during the process [1500]. Thermophysical properties of ice creams were experimentally determined [1501]. A two-dimensional model accounting for variable transport properties and radial shrinkage was used to predict temperature profiles in meat patties during double-sided cooking [1502]. Verboven et al. [1503] simulate flow and heat transfer inside a large microwave oven and find that a combined convection regime is beneficial for heat transfer uniformity and reduction of moisture accumulation inside the oven. Physical properties of doughnut dough during deep-fat frying at different temperatures are experimentally determined [1504].

20.7. Miscellaneous

Experimental investigations are performed to measure the heat transfer on the rotor tip and casing of a gas turbine stage with a shroudless rotor blade [1505]. A study of combustion instability indicates that transverse pressure oscillations can increase heat transfer to the walls up to about twofold for oscillations of 50% of the mean pressure [1506]. An extended Marker and Cell (MAC) method is used for simulating droplet combustion to obtain spatial distributions of heat rate and temperature and formation, decomposition and transfer of combustion products [1507]. A simple model allowing for the calculation of the thermal field inside a metal-coated fiber tip is performed to simulate optical tips used in scanning near-field microscopy [1508]. The effects of line speed, strip width and temperature, and inductor mixing in an industrial continuous galvanizing bath are evaluated using a k–ε model and including buoyancy effects [1509]. A dimensionless number, the electrothermal number, is found to be the controlling parameter influencing the discharge time and the maximum temperature rise in the reacting zone of discharging electrochemical devices [1510]. Bejan [1511] describes constructal tree-based approaches to minimizing resistance to flow between one point (source/sink) and a volume or an area.

21. Solar energy

Papers are broadly divided into solar radiation, low-temperature solar applications, buildings, high-temperature solar applications and extraterrestrial systems. Papers on solar energy that do not focus on heat transfer, for example, papers on photovoltaics (except for those that deal with combined thermal systems), wind energy, architectural aspects of buildings, and control of space heating or cooling systems are not included.

21.1. Radiation

Papers in this category that present model or data analysis for specific sites are [1512–1516]. Petela [1517] and Candau [1518] discuss thermal radiation exergy.

Most papers in this category present modified modeling approaches to simulate, evaluate or use measured solar data. An investigation of the performance of broadband direct irradiance predictions using 21 solar radiation models recommends the MLWT2 model [1519,1520]. Ibannez [1521] proposes a bi-exponential probability density function to predict daily clearness indices. A new multisensor algorithm for extracting longwave, shortwave, and latent heat fluxes over oceans from the sensors aboard the Tropical Rainfall Measuring Mission is described in [1522]. A model based on machine learning to generate synthetic hourly global radiation is compared to recorded data [1523]. Use of fuzzy logic to determine daily UV radiation from daily global radiation [1524] and irradiance on inclined surfaces [1525] are presented. A model to simulate permafrost thermal regimes was validated against measurements in four sites in Canada [1526].

A method to calibrate pyranometers for measuring the diffuse component is based on the modified shade/unshade method [1527]. A simple procedure to determine sky temperature, clear sky index using a heated plate is proposed [1528].

21.1.1. Low temperature applications

Low temperature solar applications include solar water heating, space cooling, refrigeration, desalination, cooking, and agricultural applications. Within this category, papers on non-concentrating solar thermal collectors and thermal storage are discussed.

21.2. Flat-plate and low-concentrating collectors

Nickel nanoparticles embedded in a dielectric matrix of alumina are fabricated and tested as selective coatings [1529]. Improvements in collector efficiency of 4–6% points are attributed to antireflective glazings [1530]. Radiative heat transfer in glazings is modeled by treating the glazing as a non-gray plane-parallel medium [1531]. Calculations of the total infrared transmittance of Tedlar films are presented based on available spectral transmittance measurements [1532]. Limiting values for clearness index, orientation and slopes for which it is reasonable to assume isotropic diffuse conditions to calculate mean daily transmittance of glazings are presented [1533]. The problem of moisture in flat-plate collectors is addressed and guidelines for dealing with the problem are proposed [1534]. A detailed model of the thermal conductivity of zirconia fibrous insulation addresses backscatter and absorption ratio for different sized fibers [1535]. The use of porous media in a water-filled curved flow channel did not improve the collector daily efficiency [1536]. A numerical study of mixed convection in a differentially heated channel consider optimal placement of inlet and outlet ports [1537]. An exergy analysis is presented to determine the optimum outlet temperature of the working fluid and flow path length for various solar collector configurations [1538]. Kudish et al. [1539] conducted experiments with a coaxial tubular collector fabricated from plastic. Fundamental studies of potential interest to the design of solar collectors are a numerical simulation of natural convection in a shallow wedge [1540] and analysis of the temperature distribution in an infinite horizontal layer of fluid filled with saturated porous medium with one radiative boundary and imposed downward convection [1541].

Hybrid photovoltaic/solar thermal collectors continue to gain attention. A dynamic model was developed for a single-glazed PV/thermal collector by Chow [1542]. Zondag et al. [1543] evaluate various configurations and concludes that the channel below-transparent-PV design gives the best performance, but the PV-on-sheet-and-tube design is easier is manufacture.

Thermophotovoltaic generators are considered in [1544–1546].

21.3. Water heating

Innovations in the design of systems for heating water are proposed. Control methods of domestic hot water systems are compared in [1547]. Doughery [1548] provides field data for a PV powered water heater with emphasis on the controls. A polymeric ICS system under development in the US is discussed and natural convection heat transfer coefficients are developed for the immersed heat exchanger in [1549]. Parametric analysis of a large unglazed swimming pool collector is presented by Medved et al. [1550]. Two water heating configurations that minimize the use of backup water heating are described and analyzed for a range of climatic conditions [1551]. Heat transfer rates in polypropylene tubes are measured by Razavi et al. [1552]. An ICS design that minimizes heat loss during non-collection periods is tested and shows favorable results [1553]. Reliability issues are addressed in a study of water scaling by Baker and Vliet [1554]. A wrap around heat exchanger is suggested to mitigate scaling problems. Shah and Furbo [1555] present a CFD model and experiments to demonstrate the impact of inlet design on flow patterns in the water storage tank. Zachar [1556] evaluates the use of impact plates in front of the inlet to decrease mixing. Chyng et al. [1557] provide and compare a model of a solar assisted heat pump water heater to experimental data.

A trial of GIS software to assist city planners to increase the use of solar water heating is presented [1558].

21.4. Cooling and refrigeration

Heat and mass transfer of a solar adsorbent cooling system in which the adsorber is a metal tube packed with activated carbon/methanol pair surrounded by a vacuum tube glazing is presented in [1559]. The use of evacuated tubes in solar adsorption is also considered by Li and Wang [1560]. Several papers present models and experiments of a proposed binary ammonia water mixture cycle that produces both power and refrigeration [1561–1563]. Mago and Goswami [1564] present field tests of a hybrid solar liquid desiccant system in Florida. An analysis of a LiBr/water cold storage operated in series with an R-123 chiller is presented in [1565]. Several arrangements of a shallow pond covered with a wetted cloth for roof cooling were tested [1566].

Papers on ice making propose various configurations. A porous adsorbent bed in a flat plate collector is modeled in [1567]. Cerci [1568] proposes an evaporative freezing cycle for water using low temperature heat. Experiments to measure the discharge characteristics of an external ice-on-coil storage tank provide suggestions for improved performance [1569].

21.5. Storage

Papers in this section address latent heat storage. Integration of energy storage with heat pumps is addressed in [1570,1571]. Stritih [1572] reviews the use of phase-change materials in buildings and considers the use of fins in a storage wall. Lamberg [1573] predicts the solid–liquid interface location and temperature distribution of a semi-infinite phase-change material with an internal fin. Lin et al. [1574] present data for a building storage system that uses alcohol in a thermosyphon loop. The influence of Jacob number and thermal conductivity on solidification of encapsulated salt hydrates is modeled by [1575]. Experiments of melting and solidification of eutectic mixtures are conducted by Baran and Sari [1576]. A simplified model of ice making is used to evaluate control strategies for ice storage systems [1577]. The use of R113 for passive heating of buildings is modeled in [1578]. Experience with hydrogen storage integrated with PV and batteries in a library in Germany is presented by Ghosh et al. [1579]. A comparison of hydrogen storage to a diesel-generator system is presented in [1580].

Sensible heat storage papers for water heating are discussed in the section on water heating.

21.6. Water treatment

A simple water purifier made of black plastic sheeting covered by glass is used to convert seawater into potable water [1581]. Photocatalytic detoxification of water soluble pesticides [1582] and toluene [1583] is investigated.

21.7. Solar desalination and solar ponds

Papers in this section are restricted to systems that use solar energy. Volume 75 issue number 5 of Solar Energy is devoted to desalination. Delyannis [1584] presents an historical overview. Garcia-Rodriguez [1585] provides a perspective of development of solar desalination. Tzen and Morris [1586] give an overview of renewable energy sources for desalination and Tiwari et al. [1587] review the present status of solar distillation. Other papers present data for specific concepts or installations [1588–1592]. Desalination includes a number of papers on solar plants and design concepts [1593–1596].

Salt-gradient solar ponds are the subject of [1597–1599]. Spyridonos et al. compare saltless solar ponds, one with a thin layer of paraffin oil on the surface and the other covered with floating glass [1600].

21.8. Solar agricultural applications and solar cooking

Performance of 250 solar cooking systems used by single families or by institutions in many parts of the word is described in [1601]. Recommendations for cooking vessel design are given in [1602]. Drying rates of various foods in open air sun dyers are compared in [1603]. Experimental evaluation of a natural convection solar dryer and biomass burner were conducted [Bena].

21.9. Buildings

This section includes papers on building integrated solar systems, heat transfer in building components, and glazings. An overview of the Solar Decathlon, for which university teams build solar houses on the National Mall in Washington, DC, as well an overview of recent progress in solar building technology is provided in [1604]. Fanney et al. [Fanney, Weise et al.] provide operational data and energy savings of a PV system installed in 2001 at the US National Institute of Standards and Technology building in Gaithersburg, MD. The use of solar panels incorporated into the roof structure is discussed and an analysis of the interconnection of solar panels, thermal storage and a heat pump for such a structure is provided in [1605]. Ubertini [1606] describes the R&D for a European pilot installation of a solar air heater for a high school.

Models for passive building performance include evaluation of various renewable energy options for a house in Germany [1607], room transfer functions [1608], prediction of indoor wall heat fluxes [1609], transient and steady-state thermal behavior of structural wall designs [1610], skylight design tools [1611], and heat transfer through domed or vaulted roofs [1612].

Various ventilation methods are analyzed. Refs. [1613–1615] analyze the use of ventilated facades and roofs to reduce summer loads. Results indicate that ventilated facades perform better than conventional glazed facades in the summer. Kim et al. [1616] model a triple-glazed ventilating window to determine optimum air flow rate for maximum energy savings. A model of natural ventilation with a solar chimney and adsorption cooling cavity predicts airflow rates [1617].

With application to daylighting, Andersen et al. [1618] compare measurements and a simplified model of the bidirectional transmission distribution function for prismatic glazing. Heat transfer across a glass sheet is modeled to show the impact of glass thickness on total heat gain, and shading coefficient [1619].

21.9.1. High temperature applications

High temperature solar thermal applications require use of concentrated solar energy. Uses include electricity generation, thermochemical reactors and industrial process heat. Papers address processes as well as system components such as heliostats, concentrators, and receivers/reactors.

Mancini et al. [1620] overview the development and status of dish-Stirling systems for power generation. Systems under development for commercial markets are reviewed. A procedure to construct the slope map of heliostats based on recording the light of a star at night is explained in [1621]. A method to determine the effective size of the solar cone for solar concentrating systems is developed [1622]. A sunshape model, which is independent of geographic location and is based on data from the US and Europe, is presented [1623]. The same paper provides an algorithm to model the spatial energy distribution across the solar disk and aureole. Johnston et al. [1624] compare the optical performance and manufacturing feasibility of dish concentrators with spherical reflector subcomponents mounted with a paraboloidal orientation. Londono-Hurtado and Rivera-Alvarez [1625] model the impact of design parameters on the performance of volumetric absorption solar collectors. A new system that uses the UV-B wavelength range for pyrometry is shown to be accurate to 10 K [1626]. A description of a point focusing two-axis tracking concentrating power plant (the multi-tower solar array) is in [1627]. A method to optimize the receiver working temperature and heliostat field density for operation of processes above 1100 K in solar towers demonstrates that there is an optimal operating temperature for maximum efficiency [1628]. Operation of a second prototype of the HiTRec-II at Plataforma Solar deAlmeria in 2000–2001 is described in [1629]. Long-term durability tests of reflector materials and field experience with silvered thin glass and anodized aluminum mirrors are reported [1630]. Heat loss measurements at the dish collecting system at the Korea Institute of Energy Research are reported in [1631].

Direct steam generation in parabolic troughs from the European DISS project is presented in [1632]. An evaluation of the use of molten salt as the heat transfer fluid and for storage in parabolic troughs indicates that levelized electricity cost can be reduced by 14% compared to SEGS plants [1633]. Thermal stability and corrosivity of various ionic liquids intended as the heat transfer/storage fluid were investigated [1634]. Chemical and thermal properties of room temperature ionic fluids are the subject of [1635]. Nunes [1636] point out the importance of obtaining accurate data on viscosity and thermal conductivity of ionic liquids at high temperature. An analysis of steam generation in a system of two parallel pipes produced unfavorable results [1637].

Solar thermochemical processes continue to gain attention for the production of solar fuels. Sustainability is discussed in [1638]. The optical design of a high-flux solar simulator at ETH-Zurich is described [1639]. Results for the combined ZnO-reduction and CH_4-reformation process show thermal efficiencies of 15–22% [1640]. Radiation analysis of a two cavity receiver/reactor for gas and condensed phases provides design curves [1641]. A model of the thermal decomposition of natural gas to produce hydrogen determines the amount of hydrogen that could be produced from a given reactor size and heliostat field [1642]. Coupling of a tubular reformer with solar tower beam-down optics is analyzed to estimate electricity capacity [1643].

Solar chimney power production is the subject of [1644–1649]. Measured total-to-static efficiencies of a solar chimney turbine are about 80% [1644]. Models of solar chimneys are provided by [1645,1647] and compared to experiment [1646]. Calculations of pressure and density are presented in [1649]. Experiments in a 0.63 m diameter model chimney with and without bracing wheels provide design guidelines for placement for bracing wheels [1648].

21.10. Extraterrestrial systems

Ammonia heat pipes were tested for the solar battery drive of the International Space Station [1650]. An exergy analysis of space solar heat receivers is presented [1651]. A numerical model to optimize the space solar dynamic system is presented in [1652]. The use of three, rather than one, phase-change materials in the NASA 2 KW solar dynamic power system is tested. Results show that it is possible to reduce temperature fluctuations and heat receiver weight [1653].

22. Plasma heat transfer and magnetohydrodynamics

The trend of characterizing plasmas in configurations appearing in specific applications has been continuing in particular in model formulations, and it has become difficult to separate general plasma characterization efforts from advances in specific applications. Accordingly, this review is structured according to configurations that are being described.

22.1. Plasma characterization and electrode effects

A model is presented for calculating the thermal conductivity in reactive non-equilibrium plasmas, in particular for different heavy particle and electron temperatures [1654]. A model of the complete characteristics of a glow discharge as it is used for analytical spectroscopy has been formulated by Bogaerts et al. [1655], and a combination of Monte Carlo and computational fluid dynamics together with a collisional-radiative radiation transport model has been used. Spectroscopic measurements in the plasma created by a strong shock wave yielded electron density data, and the discrepancy between the experimental and theoretical results point toward some shortcomings in the conventional modeling approaches [1656]. An arc-flow simulation of the heat transfer to a cathode resulted in predictions of cathode lifetimes for different operating conditions [1657]. A combined experimental and theoretical study of copper cathode erosion in case of a magnetically moved arc attachment has shown the limited range of magnetic field magnitudes for which the erosion can be reduced [1658]. Anode heating by electron impact in a vacuum has been simulated using a Monte Carlo technique [1659]. Plasma generation of nanoparticles is the topic of a paper by Eom et al. [1660], who describe the analysis of laser incandescence for determination of particle sizes.

22.2. Plasma torch and jet characterization and plasma–particle interaction

The use of three-dimensional (3-D) models to more realistically describe plasmas in specific configurations continues to increase. A 3-D simulation is used to describe an arc inside a plasma torch, and Steenbeck's minimum principle is invoked to derive a value for the preferred anode attachment location [1661]. The same computational approach is used to describe the 3-D effects when cold gas and solid particles are injected into the plasma flow [1662]. In a simulation of a turbulent argon plasma jet issuing into cold air, the entrainment of the cold air is described using a model for the multicomponent reacting gas mixture [1663]. This model is compared with results of some elegant experimental measurements obtained using a combination of different diagnostics, including enthalpy probes, laser scattering and two-photon LIF for detecting the lower temperature of the oxygen entrained in the hot argon plasma [1664]. Interaction between a plasma and particles injected into the plasma jet is studied numerically by Wan et al. [1665] with a similar code as that used by Wiliamson et al. [1663], and the trajectories and heating histories are simulated for two types of particles, injected at different locations. The effects of particle injection on the characteristics of an argon plasma jet issuing into cold air are described in a 3-D simulation for dense loading conditions [1666]. The same authors describe with a similar 3-D model the evaporation of water injected into the plasma jet and the deformation of the plasma jet due to asymmetric cooling [1667]. The plasma–particle interaction between a rf-generated plasma and silicon particles is described by Amouroux et al. [1668] and the effects of evaporation on the heat flux to the particles are pointed out. The effects of the rf field on the particles in a plasma nozzle flow is described by [1669].

Measurements of particle temperature and velocity distributions in a plasma jet are compared with model predictions for different operating conditions by Planche et al. [1670]. Investigations of the coating obtained by plasma co-spraying of two different materials have shown that the minimum power level to obtain the desired composition has to be sufficiently high to assure melting of the higher melting point material [1671]. The change in heat transfer from a plasma jet to a substrate during plasma spray deposition is described by Meng et al. [1672].

22.3. Transferred arc characterization for electric arc furnace and welding simulation

An interesting simulation of the post combustion processes in an electric arc furnace uses a combination of CFD and chemical reaction models, and the effect on the heat transfer to the melt and the electrode erosion is predicted [1673]. Another model of a dc electric arc furnace derives a description of the arc in dimensionless form allowing quick determination of the effects of operating parameter changes [1674]. The effects of external magnetic fields on the arc in an electric arc furnace configuration are described in a 3-D simulation by Blais et al. [1675]. In an experimental study of a pilot plant scale arc furnace it has been demonstrated that introducing methane into the argon arc not only increases the arc voltage and power, but also reduces the nitrogen content in the steel [1676]. A comprehensive model of a welding arc describes not only the cathode and the arc but also the fluid dynamics in the weld pool, and the effects of changing surface tension of the liquid metal on the flow inside the pool [1677]. The enhancement of the surface alloying process when a combination of plasma arc and laser irradiation is used is described by McCay et al. [1678], and the appearance of a synergistic effect is pointed out.

22.4. Magnetohydrodynamics

Besides three experimental studies investigating specific configurations, a number of theoretical studies concerned themselves with effects of turbulence, heat transfer studies in specific configurations including in porous media and with non-Newtonian fluids.

A combined experimental and analytical study of a thermosyphon closed MHD loop resulted in the measurement of induced flowrates and open circuit voltages for different operating conditions [1679]. The effect of a varying Hartmann number in a liquid metal flow in a vertical slot with a horizontal field has been investigated by measuring the temperature distributions, and an increase in Hartmann number has resulted in changes from large temperature fluctuations indicating presence of large vortices and strong convective transport to essentially pure conduction [1680]. Visualization of MHD flow has been accomplished by using a transparent electrolyte and shadowgraph techniques and tracer particles, and the changes of the flow patterns due to the presence of magnetic fields are described [1681].

A modified one-equation turbulence model for turbulent MHD flow is presented, and this model has been used to describe the observed relaminarization effects, as well as to predict a reduction in skin friction for supersonic flows over flat plates [1682]. Another numerical study of conduction in turbulent MHD gas flows finds that the turbulent diffusion is not suppressed by the magnetic field [1683]. The influence of magnetic fields on the velocity profiles of a particle laden gas flow in a hexagonal channel are described by Sharma and Varshney [1684], including the effects of thermal dispersion and viscous dissipation. A simulation of transient flow between two parallel plates at different temperatures considered the temperature dependencies of viscosity and thermal conductivity for determining the velocity and temperature distributions [1685]. Flow of miscible fluids in a capillary tube with a magnet moving with the flow have been investigated numerically, and the spread of the mixing layer and the change of the center of gravity are given [1686]. A 3-D numerical simulation of a Faraday generator including radiation transport finds increases of the current density near the electrodes and high local emission coefficients, however most radiation is reabsorbed [1687]. The influence of thermocapillary forces and free convection in liquid metal flow in partially open cavities has been simulated by Sundaravadivelu and Kandaswamy [1688], and the suppression of the convective transport inside the cavity by the magnetic field is shown. A simulation of liquid metal/helium gas dual cooling of the waste transmutation blanket in a fusion reactor shows that increasing the Hartmann number will increase the heat transfer but also the pressure drop [1689]. Laminar MHD flow over an accelerating surface with suction or injection has been simulated with inclusion of chemical reactions [1690]. Free convection flow along vertical or inclined plates have been simulated numerically for a porous plate and unsteady flow and suction or injection [1691], in a porous medium [1692], in a porous medium with inclusion of viscous dissipation and radiation and time varying suction [1693], and using a similarity analysis [1694]. Another numerical analysis of a flow with internal heat generation over an infinite plate is presented by Eldabe et al. [1695], and over a non-isothermal horizontal cylinder in a porous matrix by El-Amin [1696]. Free convection MHD flow through a porous medium is described in a 3-D simulation by Jat and Jankal [1697]. Analytic solutions of MHD flow of non-Newtonian fluids are presented for flow over a stretching sheet [1698], for flow over a porous stretching sheet [1699], and for flow within a porous medium near an accelerated plate [1700].

References

[1] A. Bairi, Analytical model for thermal resistance due to multiple moving circular contacts on a coated body, C. R. Acad. Sci. II-Mec. 331 (8) (2003) 557–562.

[2] B. Bourouga, V. Goizet, J.P. Bardon, Predictive model of dynamic thermal contact resistance adapted to the workpiece–die interface during hot forging process, Int. J. Heat Mass Transfer 46 (3) (2003) 565–576.

[3] A. Degiovanni, B. Remy, S. Andre, Thermal resistance of a multi-constrictions contact: a simple model, Int. J. Heat Mass Transfer 46 (19) (2003) 3727–3735.

[4] R.S. Prasher, J. Shipley, S. Prstic, P. Koning, J.L. Wang, Thermal resistance of particle laden polymeric thermal interface materials, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1170–1177.

[5] I. Savija, M.M. Yovanovich, J.R. Culham, E.E. Marotta, Thermal joint resistance of conforming rough surfaces with grease-filled interstitial gaps, J. Thermophys. Heat Transfer 17 (2) (2003) 278–282.

[6] J.C. Chen, Surface contact—its significance for multiphase heat transfer: diverse examples, J. Heat Transfer-Trans. ASME 125 (4) (2003) 549–566.

[7] M. Jordan-Steen, G.C. Barber, M. Shillor, The heat exchange coefficient function in thermoelastic contact (c), Lubricat. Eng. 59 (3) (2003) 10–16.

[8] S.S. Kumar, K. Ramamurthi, Influence of flatness and waviness of rough surfaces on surface contact conductance, J. Heat Transfer-Trans. ASME 125 (3) (2003) 394–402.

[9] G. Le Meur, B. Bourouga, T. Dupuy, Measurement of contact parameters at electrode/sheet interface during resistance spot welding process, Sci. Technol. Weld. Join. 8 (6) (2003) 415–422.

[10] I. Savija, J.R. Culham, M.M. Yovanovich, E.E. Marotta, Review of thermal conductance models for joints incorporating enhancement materials, J. Thermophys. Heat Transfer 17 (1) (2003) 43–52.

[11] N.S. Venkataraman, E.G. Perez, I. Delgado-Velazquez, Temperature distribution in spacecraft mounting plates with discrete heat generation sources due to conductive heat transfer, Acta Astronaut. 53 (3) (2003) 173–183.

[12] S.M.S. Wahid, C.V. Madhusudana, Thermal contact conductance: effect of overloading and load cycling, Int. J. Heat Mass Transfer 46 (21) (2003) 4139–4143.

[13] M. Al-Nimr, M. Naji, S. Al-Wardat, Overshooting phenomenon in the hyperbolic heat conduction model, Jpn. J. Appl. Phys. Part 1-Regular Papers Short Notes & Review Papers 42 (8) (2003) 5383–5386.

[14] M. Al-Nimr, B.A. Abu-Hijleh, M. Hader, Effect of thermal losses on the microscopic hyperbolic heat conduction model, Heat Mass Transfer 39 (2003) 201–207.

[15] A.L. Koay, S.H. Pulko, A.J. Wilkinson, Reverse time TLM modeling of thermal problems described by the hyperbolic heat conduction equation, Numer. Heat Transfer B-Fundament. 44 (4) (2003) 347–363.

[16] S.A. Sarra, Spectral methods with postprocessing for numerical hyperbolic heat transfer, Numer. Heat Transfer Part A-Appl. 43 (7) (2003) 717–730.

[17] J.K. Chen, J.E. Beraun, L.E. Grimes, D.Y. Tzou, Short-time thermal effects on thermomechanical response caused by pulsed lasers, J. Thermophys. Heat Transfer 17 (1) (2003) 35–42.

[18] S. Galovic, D. Kostoski, G. Stamboliev, E. Suljovrujic, Thermal wave propagation in media with thermal memory induced by pulsed laser irradiation, Rad. Phys. Chem. 67 (3–4) (2003) 459–461.

[19] E. Hoashi, T. Yokomine, A. Shimizu, T. Kunugi, Numerical analysis of wave-type heat transfer propagating in a thin foil irradiated by short-pulsed laser, Int. J. Heat Mass Transfer 46 (21) (2003) 4083–4095.

[20] M. Kalyon, B.S. Yilbas, Laser pulse heating: a formulation of desired temperature at the surface, Opt. Lasers Eng. 39 (1) (2003) 109–119.

[21] S.H. Lee, J.S. Lee, S. Park, Y.K. Choi, Numerical analysis on heat transfer characteristics of a silicon film irradiated by pico- to femtosecond pulse lasers, Numer. Heat Transfer Part A-Appl. 44 (8) (2003) 833–850.

[22] S.I. Serdyukov, N.M. Voskresenskii, V.K. Belnov, Karpov II, Extended irreversible thermodynamics and generalization of the dual-phase-lag model in heat transfer, J. Non-Equilibrium Thermodynam. 28 (3) (2003) 207–219.

[23] I. Shnaid, Thermodynamically consistent description of heat conduction with finite speed of heat propagation, Int. J. Heat Mass Transfer 46 (20) (2003) 3853–3863.

[24] B.S. Yilbas, Entropy analysis in an Au–Cr two-layer assembly during laser shortpulse heating, Numer. Heat Transfer Part A-Appl. 43 (2) (2003) 179–199.

[25] B.S. Yilbas, Laser shortpulse heating of gold: variable properties case, Int. J. Heat Mass Transfer 46 (18) (2003) 3511–3520.

[26] M.A. Al-Nimr, M. Hader, M. Naji, Use of the microscopic parabolic heat conduction model in place of the macroscopic model validation criterion under harmonic boundary heating, Int. J. Heat Mass Transfer 46 (2) (2003) 333–339.

[27] J.R. Ho, C.P. Kuo, W.S. Jiaung, Study of heat transfer in multilayered structure within the framework of dual-phase-lag heat conduction model using lattice Boltzmann method, Int. J. Heat Mass Transfer 46 (1) (2003) 55–69.

[28] C.S. Tsai, C.I. Hung, Thermal wave propagation in a bi-layered composite sphere due to a sudden temperature change on the outer surface, Int. J. Heat Mass Transfer 46 (26) (2003) 5137–5144.

[29] T.F. Zeng, W. Liu, Phonon heat conduction in micro- and nano-core-shell structures with cylindrical and spherical geometries, J. Appl. Phys. 93 (7) (2003) 4163–4168.

[30] Y.M. Chen, S.W. Wang, Z. Zuo, A procedure for calculating transient thermal load through multilayer cylindrical structures, Appl. Therm. Eng. 23 (16) (2003) 2133–2145.

[31] A. Haji-Sheikh, J.V. Beck, D. Agonafer, Steady-state heat conduction in multi-layer bodies, Int. J. Heat Mass Transfer 46 (13) (2003) 2363–2379.

[32] H.L. Lee, Y.C. Yang, Function estimation in predicting time-dependent heat flux of an annular fin, J. Therm. Stress. 26 (8) (2003) 799–813.

[33] W. Manners, Effect of gap size and spacing on heat conduction between materials with irregularly spaced plane strip contacts, Proc. Institut. Mech. Eng. Part C-J. Mech. Eng. Sci. 217 (4) (2003) 457–466.

[34] W. Nakayama, A methodology to work on geometrically complex heat transfer systems: the cases of heat conduction through composite slabs, Int. J. Heat Mass Transfer 46 (18) (2003) 3397–3409.

[35] M.Q. Zou, B.M. Yu, D.M. Zhang, Y.T. Ma, Study on optimization of transverse thermal conductivities of unidirectional composites, J. Heat Transfer-Trans. ASME 125 (6) (2003) 980–987.

[36] F. de Monte, Unsteady heat conduction in two-dimensional two slab-shaped regions. Exact closed-form solution and results, Int. J. Heat Mass Transfer 46 (8) (2003) 1455–1469.

[37] M. Monde, H. Arima, W. Liu, Y. Mitutake, J.A. Hammad, An analytical solution for two-dimensional inverse heat conduction problems using Laplace transform, Int. J. Heat Mass Transfer 46 (12) (2003) 2135–2148.

[38] M. Monde, H. Arima, Y. Mitsutake, Estimation of surface temperature and heat flux using inverse solution for one-dimensional heat conduction, J. Heat Transfer-Trans. ASME 125 (2) (2003) 213–223.

[39] S. Amjad, A. Abdelbaki, Z. Zrikem, Transfer functions method and sub-structuration technique for two-dimensional heat conduction problems in high thermal mass systems—application to ground coupling problems, Energy Build. 35 (6) (2003) 593–604.

[40] J.Y. Murthy, S.R. Mathur, An improved computational procedure for sub-micron heat conduction, J. Heat Transfer-Trans. ASME 125 (5) (2003) 904–910.

[41] S.V.J. Narumanchi, J.Y. Murthy, C.H. Amon, Simulation of unsteady small heat source effects in sub-micron heat conduction, J. Heat Transfer-Trans. ASME 125 (5) (2003) 896–903.

[42] R.V. Preston, H.R. Shercliff, P.J. Withers, S.D. Smith, Finite element modelling of tungsten inert gas welding of aluminium alloy 2024, Sci. Technol. Weld. Join. 8 (1) (2003) 10–18.
[43] M.R. Siddique, R.E. Khayat, Transient linear and nonlinear heat conduction in weakly modulated domains, Numer. Heat Transfer Part A-Appl. 43 (5) (2003) 481–500.
[44] I.V. Singh, K. Sandeep, R. Prakash, Heat transfer analysis of two-dimensional fins using a meshless element free Galerkin method, Numer. Heat Transfer Part A-Appl. 44 (1) (2003) 73–84.
[45] P. Tsourkas, B. Rubinsky, Evolutionary-genetic algorithm for solving 2-D steady-state conduction problems, Numer. Heat Transfer B-Fundament. 43 (2) (2003) 99–115.
[46] D.B. Xiu, G.E. Karniadakis, A new stochastic approach to transient heat conduction modeling with uncertainty, Int. J. Heat Mass Transfer 46 (24) (2003) 4681–4693.
[47] B. Xu, B.Q. Li, Finite element solution of non-Fourier thermal wave problems, Numer. Heat Transfer B-Fundament. 44 (1) (2003) 45–60.
[48] F.H. Milanez, J.R. Culham, M.M. Yovanovich, Experimental thermal contact conductance of bead-blasted SS 304 at light loads, J. Thermophys. Heat Transfer 17 (4) (2003) 534–536.
[49] F.H. Milanez, M.B.H. Mantelli, Theoretical and experimental studies of a bi-metallic heat switch for space applications, Int. J. Heat Mass Transfer 46 (24) (2003) 4573–4586.
[50] P. Prabhat, D.C. Look, S.N. Balakrishnan, Experimental model determination for neurocontrol of a thermal conduction system, J. Thermophys. Heat Transfer 17 (4) (2003) 471–480.
[51] M. Rosochowska, R. Balendra, K. Chodnikiewicz, Measurements of thermal contact conductance, J. Mater. Process. Technol. 135 (2–3) (2003) 204–210.
[52] C.L. Yeh, Y.F. Chen, C.Y. Wen, K.T. Li, Measurement of thermal contact resistance of aluminum honeycombs, Exp. Therm. Fluid Sci. 27 (3) (2003) 271–281.
[53] M. Naji, M.A. Al-Nimr, M. Mallouh, Thermal stresses under the effect of the microscopic heat conduction model, J. Therm. Stress. 26 (1) (2003) 41–53.
[54] M. Ostoja-Starzewski, Thermoelastic waves in a helix with parabolic or hyperbolic heat conduction, J. Therm. Stress. 26 (11–12) (2003) 1205–1219.
[55] A. Bairi, N. Laraqi, Diagrams for fast transient conduction in sphere and long cylinder subject to sudden an violent thermal effects on its surface, Appl. Therm. Eng. 23 (11) (2003) 1373–1390.
[56] G.C.J. Bart, K. Hanjalic, Estimation of shape factor for transient conduction, Int. J. Refrig.-Rev. Int. Froid 26 (3) (2003) 360–367.
[57] P.E. Ergatis, P.G. Massouros, G.C. Athanasouli, G.P. Massouros, Time-dependent heat transfer coefficient of a wall, Int. J. Energy Res. 27 (9) (2003) 795–811.
[58] K. Fukuyo, Heat flow visualization for thermal bridge problems, Int. J. Refrig.-Rev. Int. Froid 26 (5) (2003) 614–617.
[59] Z.Y. Guo, X.G. Cheng, Z.Z. Xia, Least dissipation principle of heat transport potential capacity and its application in heat conduction optimization, Chin. Sci. Bull. 48 (4) (2003) 406–410.
[60] A.V. Gusarov, T. Laoui, L. Froyen, V.I. Titov, Contact thermal conductivity of a powder bed in selective laser sintering, Int. J. Heat Mass Transfer 46 (6) (2003) 1103–1109.
[61] Y.L. Jiang, Rapid energy transfer annealing for the crystallization of amorphous silicon, Jpn. J. Appl. Phys. Part 2-Lett. 42 (8B) (2003) L999–L1001.
[62] N. Mendes, F.C. Winkelmann, R. Lamberts, P.C. Philippi, Moisture effects on conduction loads, Energy Build. 35 (7) (2003) 631–644.
[63] A.A. Ozalp, H. Umur, An experimental investigation of the combined effects of surface curvature and streamwise pressure gradients both in laminar and turbulent flows, Heat Mass Transfer 39 (10) (2003) 869–876.
[64] T.Y. Chen, R.K. Du, Effects of velocity fluctuations on heat transfer enhancement, Exp. Fluids 34 (5) (2003) 548–555.
[65] M.J. Barrett, D.K. Hollingsworth, Heat transfer in turbulent boundary layers subjected to free-stream turbulence—Part 1: Experimental results, J. Turbomach.-Trans. ASME 125 (2) (2003) 232–241.
[66] M.J. Barrett, D.K. Hollingsworth, Heat transfer in turbulent boundary layers subjected to free-stream turbulence—Part II: Analysis and correlation, J. Turbomach.-Trans. ASME 125 (2) (2003) 242–251.
[67] F.E. Ames, P.A. Barbot, C. Wang, Effects of aeroderivative combustor turbulence on endwall heat transfer distributions acquired in a linear vane cascade, J. Turbomach.-Trans. ASME 125 (2) (2003) 210–220.
[68] F.E. Ames, C. Wang, P.A. Barbot, Measurement and prediction of the influence of catalytic and dry low NO_x combustor turbulence on vane surface heat transfer, J. Turbomach.-Trans. ASME 125 (2) (2003) 221–231.
[69] X. Escriva, A. Giovannini, Analysis of convective momentum and wall heat transfer: application to vortex boundary layer interaction, Int. J. Heat Mass Transfer 46 (13) (2003) 2471–2483.
[70] A. Lefevre, J.P.B. Mota, A.J.S. Rodrigo, E. Saatdjian, Chaotic advection and heat transfer enhancement in Stokes flows, Int. J. Heat Fluid Flow 24 (3) (2003) 310–321.
[71] J. Kim, Z. Rusak, N. Koratkar, Small-scale airfoil aerodynamic efficiency improvement by surface temperature and heat transfer, AIAA J. 41 (11) (2003) 2105–2113.
[72] M. Chandrasekar, Analytical study of heat transfer and boundary layer flow with suction and injection, Heat Mass Transfer 40 (1–2) (2003) 157–165.
[73] Q. Wan, A.V. Kuznetsov, Numerical study of the efficiency of acoustic streaming for enhancing heat transfer between two parallel beams, Flow Turbul. Combust. 70 (1–4) (2003) 89–114.
[74] E.M. Abo-Eldahab, A.F. Ghonaim, Convective heat transfer in an electrically conducting micropolar fluid at a stretching surface with uniform free stream, Appl. Math. Comput. 137 (2–3) (2003) 323–336.
[75] S.W. Bae, S.K. Lele, H.J. Sung, Direct numerical simulation of stagnation region flow and heat transfer with free-stream turbulence, Phys. Fluids 15 (6) (2003) 1462–1484.
[76] H. Yanaoka, H. Yoshikawa, T. Ota, Direct numerical simulation of turbulent separated flow and heat transfer over a blunt flat plate, J. Heat Transfer-Trans. ASME 125 (5) (2003) 779–787.
[77] B. Aupoix, P.R. Spalart, Extensions of the Spalart–Allmaras turbulence model to account for wall roughness, Int. J. Heat Fluid Flow 24 (4) (2003) 454–462.
[78] Y. Hagiwara, S. Takagaki, T. Yuge, Effects of a droplet on near-wall transport phenomena in turbulent downward liquid–liquid flow, J. Enhanced Heat Transfer 10 (1) (2003) 81–93.
[79] N. Afzal, Momentum transfer on power law-stretching plate with free stream pressure gradient, Int. J. Eng. Sci. 41 (11) (2003) 1197–1207.
[80] T.I.P. Shih, Y.L. Lin, Controlling secondary-flow structure by leading-edge airfoil fillet and inlet swirl to reduce aerodynamic loss and surface heat transfer, J. Turbomach.-Trans. ASME 125 (1) (2003) 48–56.
[81] M. Papa, R.J. Goldstein, F. Gori, Effects of tip geometry and tip clearance on the mass/heat transfer from a large-scale gas turbine blade, J. Turbomach.-Trans. ASME 125 (1) (2003) 90–96.
[82] P. Jin, R.J. Goldstein, Local mass/heat transfer on turbine blade near-tip surfaces, J. Turbomach.-Trans. ASME 125 (3) (2003) 521–528.
[83] V. Srinivasan, R.J. Goldstein, Effect of endwall motion on blade tip heat transfer, J. Turbomach.-Trans. ASME 125 (2) (2003) 267–273.
[84] J.S. Kwak, J.C. Han, Heat-transfer coefficients of a turbine blade-tip and near-tip regions, J. Thermophys. Heat Transfer 17 (3) (2003) 297–303.
[85] J.S. Kwak, J. Ahn, J.C. Han, C.P. Lee, R.S. Bunker, R. Boyle, R. Gaugler, Heat transfer coefficients on the squealer tip and near-tip regions of a gas turbine blade with single or double squealer, J. Turbomach.-Trans. ASME 125 (4) (2003) 778–787.

[86] N.D. Sandham, Y.F. Yao, A.A. Lawal, Large-eddy simulation of transonic turbulent flow over a bump, Int. J. Heat Fluid Flow 24 (4) (2003) 584–595.

[87] C.P. Goyne, R.J. Stalker, A. Paull, Skin-friction measurements in high-enthalpy hypersonic boundary layers, J. Fluid Mech. 485 (2003) 1–32.

[88] E.R. Van Driest, Turbulent boundary layer in compressible fluids, J. Spacecraft Rockets 40 (6) (2003) 1012–1028.

[89] M. Furudate, S. Nonaka, K. Sawada, Calculation of shock shapes over sharp cone in intermediate hypersonic airflow, J. Thermophys. Heat Transfer 17 (2) (2003) 250–258.

[90] O.A. Sinkevich, A.M. Semenov, Solution of the Boltzmann equation by expanding the distribution function with several time and coordinate scales in the Enskog series in Knudsen parameter, Tech. Phys. 48 (10) (2003) 1221–1225.

[91] E.L. Petersen, R.K. Hanson, Improved turbulent boundary-layer model for shock tubes, AIAA J. 41 (7) (2003) 1314–1322.

[92] D. D'Ambrosio, Numerical prediction of laminar shock/shock interactions in hypersonic flow, J. Spacecraft Rockets 40 (2) (2003) 153–161.

[93] I. Nompelis, G.V. Candler, M.S. Holden, Effect of vibrational nonequilibrium on hypersonic double-cone experiments, AIAA J. 41 (11) (2003) 2162–2169.

[94] J.S. Park, S.W. Baek, Interaction of a moving shock wave with a two-phase reacting medium, Int. J. Heat Mass Transfer 46 (24) (2003) 4717–4732.

[95] M. Wright, M. Loomis, P. Papadopoulos, Aerothermal analysis of the Project Fire II afterbody flow, J. Thermophys. Heat Transfer 17 (2) (2003) 240–249.

[96] B. Grisogono, Post-onset behaviour of the pure katabatic flow, Bound.-Lay. Meteorol. 107 (1) (2003) 157–175.

[97] T.S. Park, H.J. Sung, K. Suzuki, Development of a nonlinear near-wall turbulence model for turbulent flow and heat transfer, Int. J. Heat Fluid Flow 24 (1) (2003) 29–40.

[98] B.M. Mitrovic, D.V. Papavassiliou, Transport properties for turbulent dispersion from wall sources, AIChE J. 49 (5) (2003) 1095–1108.

[99] Y. Mito, T.J. Hanratty, A stochastic description of wall sources in a turbulent field. Part 1: Verification, Int. J. Multiphase Flow 29 (9) (2003) 1373–1394.

[100] F. Bataille, B.A. Younis, J. Bellettre, A. Lallemand, Prediction of turbulent heat transfer with surface blowing using a non-linear algebraic heat flux model, Int. J. Heat Fluid Flow 24 (5) (2003) 680–684.

[101] R. Pecnik, W. Sanz, A. Gehrer, J. Woisetschlager, Transition modeling using two different intermittency transport equations, Flow Turbul. Combust 70 (1–4) (2003) 299–323.

[102] S. Zhong, T.P. Chong, H.P. Hodson, A comparison of spreading angles of turbulent wedges in velocity and thermal boundary layers, J. Fluids Eng.-Trans. ASME 125 (2) (2003) 267–274.

[103] A. Ortega, S. Ramanathan, On the use of point source solutions for forced air cooling of electronic components—Part II: Conjugate forced convection from a discrete rectangular source on a thin conducting plate, J. Electron. Packag. 125 (2) (2003) 235–243.

[104] F. Malpica, N. Moreno, A. Tremante, The two-flux model applied to radiative transfer and forced convection in the laminar boundary layer on a flat plate, J. Eng. Gas Turbines Power-Trans. ASME 125 (3) (2003) 734–741.

[105] T. Coton, T. Arts, M. Lefebvre, N. Liamis, Unsteady and calming effects investigation on a very high-lift LP turbine blade—Part 1: Experimental analysis, J. Turbomach.-Trans. ASME 125 (2) (2003) 281–290.

[106] E.M.A. Elbashbeshy, M.A.A. Bazid, Heat transfer over an unsteady stretching surface with internal heat generation, Appl. Math. Comput. 138 (2–3) (2003) 239–245.

[107] Y.J. Kim, A.G. Fedorov, Transient mixed radiative convection flow of a micropolar fluid past a moving, semi-infinite vertical porous plate, Int. J. Heat Mass Transfer 46 (10) (2003) 1751–1758.

[108] H. Takamatsu, H. Yamashiro, N. Takata, H. Honda, Vapor absorption by LiBr aqueous solution in vertical smooth tubes, Int. J. Refrig.-Rev. Int. Froid 26 (6) (2003) 659–666.

[109] J.K. Kim, C.W. Park, Y.T. Kang, The effect of micro-scale surface treatment on heat and mass transfer performance for a falling film H_2O/LiBr absorber, Int. J. Refrig.-Rev. Int. Froid 26 (5) (2003) 575–585.

[110] D. Mikielewicz, Hydrodynamics and heat transfer in bubbly flow in the turbulent boundary layer, Int. J. Heat Mass Transfer 46 (2) (2003) 207–220.

[111] W.Z. Li, Y.Y. Yan, J.M. Smith, A numerical study of the interfacial transport characteristics outside spheroidal bubbles and solids, Int. J. Multiphase Flow 29 (3) (2003) 435–460.

[112] R.A. Handler, R.I. Leighton, G.B. Smith, R. Nagaosa, Surfactant effects on passive scalar transport in a fully developed turbulent flow, Int. J. Heat Mass Transfer 46 (12) (2003) 2219–2238.

[113] B.S. Dandapat, B. Santra, H.I. Andersson, Thermocapillarity in a liquid film on an unsteady stretching surface, Int. J. Heat Mass Transfer 46 (16) (2003) 3009–3015.

[114] A. Benkhaled, S.B. Saouli, C. Mbow, M. Daguenet, Numerical study of heat transfer between air and a falling ostwaldian film in permanent laminar regime on an isotherm inclined surface, Int. J. Therm. Sci. 42 (4) (2003) 425–433.

[115] D. Lakehal, M. Fulgosi, G. Yadigaroglu, S. Banerjee, Direct numerical simulation of turbulent heat transfer across a mobile, sheared gas–liquid interface, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1129–1139.

[116] T. Kunugi, C. Kino, Numerical simulation of oscillatory falling liquid film flows, Fusion Eng. Design 65 (3 Special Issue SI) (2003) 387–392.

[117] A.S. Gupta, J.C. Misra, M. Reza, Effects of suction or blowing on the velocity and temperature distribution in the flow past a porous flat plate of a power-law fluid, Fluid Dynam. Res. 32 (6) (2003) 283–294.

[118] C.H. Chen, Heat transfer in a power-law fluid film over a unsteady stretching sheet, Heat Mass Transfer 39 (8–9) (2003) 791–796.

[119] S.A. Slater, A.D. Leeming, J.B. Young, Particle deposition from two-dimensional turbulent gas flows, Int. J. Multiphase Flow 29 (5) (2003) 721–750.

[120] R.V.R. Pandya, F. Mashayek, Non-isothermal dispersed phase of particles in turbulent flow, J. Fluid Mech. 475 (2003) 205–245.

[121] B. Shotorban, F. Mashayek, R.V.R. Pandya, Temperature statistics in particle-laden turbulent homogeneous shear flow, Int. J. Multiphase Flow 29 (8) (2003) 1333–1353.

[122] R.V.R. Pandya, F. Mashayek, Kinetic equation for particle transport and heat transfer in nonisothermal turbulent flows, AIAA J. 41 (5) (2003) 841–847.

[123] N.G. Hadjiconstantinou, Dissipation in small scale gaseous flows, J. Heat Transfer-Trans. ASME 125 (5) (2003) 944–947.

[124] P.J. Daivis, M.L. Matin, Steady-state thermodynamics of shearing linear viscoelastic fluids, J. Chem. Phys. 118 (24) (2003) 11111–11119.

[125] L.N. Perepechko, Numerical study of the effect of methane combustion on heat and mass transfer and friction in the boundary layer, Combust. Explos. Shock Waves 39 (3) (2003) 255–260.

[126] R. Ananth, C.C. Ndubizu, P.A. Tatem, Burning rate distributions for boundary layer flow combustion of a PMMA plate in forced flow, Combust. Flame 135 (1–2) (2003) 35–55.

[127] F. Foucher, S. Burnel, C. Mounaim-Rousselle, M. Boukhalfa, B. Renou, M. Trinite, Flame wall interaction: effect of stretch, Exp. Therm. Fluid Sci. 27 (4) (2003) 431–437.

[128] V.P. Samsonov, Effect of vortex restructuring on heat transfer in an "inverted" flame, Combust. Explos. Shock Waves 39 (2) (2003) 126–129.

[129] R. Bandyopadhyay, P. Nylen, A computational fluid dynamic analysis of gas and particle flow in flame spraying, J. Therm. Spray Technol. 12 (4) (2003) 492–503.

[130] K. Uchiyama, H. Migita, Gas absorption into "string-of-beads" liquid flow with chemical reaction: application to carbon dioxide separation, Int. J. Heat Mass Transfer 46 (2003) 457–468.

[131] V.V. Riabov, Kinetic phenomena in spherical expanding flows of binary gas mixtures, J. Thermophys. Heat Transfer 17 (4) (2003) 526–533.

[132] S.H. Yoon, J.H. Kim, Y.W. Hwang, M.S. Kim, K. Min, Y. Kim, Heat transfer and pressure drop characteristics during the in-tube cooling process of carbon dioxide in the supercritical region, Int. J. Refrig.-Rev. Int. Froid 26 (8) (2003) 857–864.

[133] Q.H. Wang, H. Yoo, Y. Jaluria, Convection in a horizontal rectangular duct under constant and variable property formulations, Int. J. Heat Mass Transfer 46 (2003) 297–310.

[134] M. Rokni, B. Sunden, Calculation of turbulent fluid flow and heat transfer in ducts by a full Reynolds stress model, Int. J. Numer. Methods Fluids 42 (2) (2003) 147–162.

[135] M. Rokni, B. Sunden, Investigation of a two-equation turbulent heat transfer model applied to ducts, J. Heat Transfer-Trans. ASME 125 (1) (2003) 194–200.

[136] B.A. Abu-Hijleh, M.A. Al-Nimr, M.A. Hader, Thermal equilibrium in transient conjugated forced-convection channel flow, Numer. Heat Transfer Part A-Appl. 43 (3) (2003) 327–339.

[137] A. Barletta, S. Lazzari, E. Zanchini, Non-axisymmetric forced and free flow in a vertical circular duct, Int. J. Heat Mass Transfer 46 (23) (2003) 4499–4512.

[138] A. Behzadmehr, N. Galanis, A. Laneville, Low Reynolds number mixed convection in vertical tubes with uniform wall heat flux, Int. J. Heat Mass Transfer 46 (25) (2003) 4823–4833.

[139] S. Bilir, A. Ates, Transient conjugated heat transfer in thick walled pipes with convective boundary conditions, Int. J. Heat Mass Transfer 46 (14) (2003) 2701–2709.

[140] V.A. Kurganov, I.V. Maslakova, A modified model for the calculation of fully developed heat transfer and drag in tubes under conditions of turbulent flow of gases with varying physical properties, High Temperat. 41 (6) (2003) 790–800.

[141] L.D. Dalley, N. Meng, R.H. Pletcher, Large eddy simulation of constant heat flux turbulent channel flow with property variations: quasi-developed model and mean flow results, J. Heat Transfer-Trans. ASME 125 (1) (2003) 27–38.

[142] C.H. Liu, Turbulent plane Couette flow and scalar transport at low Reynolds number, J. Heat Transfer-Trans. ASME 125 (6) (2003) 988–998.

[143] M. Miyamoto, W. Shi, Y. Katoh, J. Kurima, Choked flow and heat transfer of low density gas in a narrow parallel-plate channel with uniformly heating walls, Int. J. Heat Mass Transfer 46 (14) (2003) 2685–2693.

[144] G.H. Tang, W.Q. Tao, Y.L. He, Simulation of fluid flow and heat transfer in a plane channel using the lattice Boltzmann method, Int. J. Modern Phys. B 17 (1–2) (2003) 183–187.

[145] M. Huang, F.C. Lai, Numerical study of EHD-enhanced forced convection using two-way coupling, J. Heat Transfer-Trans. ASME 125 (4) (2003) 760–764.

[146] S. Mahmud, S.H. Tasnim, M.A.H. Mamun, Thermodynamic analysis of mixed convection in a channel with transverse hydromagnetic effect, Int. J. Therm. Sci. 42 (8) (2003) 731–740.

[147] Y.P. Zhang, X.X. Hu, Q. Hao, X. Wang, Convective heat transfer enhancement of laminar flow of latent functionally thermal fluid in a circular tube with constant heat flux: internal heat source model and its application, Sci. China Ser. E-Technol. Sci. 46 (2) (2003) 131–140.

[148] Y.M. Xuan, Q. Li, Investigation on convective heat transfer and flow features of nanofluids, J. Heat Transfer-Trans. ASME 125 (1) (2003) 151–155.

[149] P. Poskas, R. Poskas, Local turbulent opposing mixed convection heat transfer in inclined flat channel for stably stratified airflow, Int. J. Heat Mass Transfer 46 (21) (2003) 4023–4032.

[150] Y. Mito, T.J. Hanratty, Lagrangian stochastic simulation of turbulent dispersion of heat markers in a channel flow, Int. J. Heat Mass Transfer 46 (6) (2003) 1063–1073.

[151] S. Mahmud, R.A. Fraser, The second law analysis in fundamental convective heat transfer problems, Int. J. Therm. Sci. 42 (2) (2003) 177–186.

[152] S.H. Lee, Laminar forced convective heat transfer to near-critical water in a tube, KSME Int. J. 17 (11) (2003) 1756–1766.

[153] J. Lahjomri, K. Zniber, A. Oubarra, A. Alemany, Heat transfer by laminar Hartmann's flow in thermal entrance region with uniform wall heat flux: the Graetz problem extended, Energy Convers. Manage. 44 (2003) 11–34.

[154] B. Weigand, F. Wrona, The extended Graetz problem with piecewise constant wall heat flux for laminar and turbulent flows inside concentric annuli, Heat Mass Transfer 39 (4) (2003) 313–320.

[155] M.C. Kim, T.J. Chung, C.K. Choi, The onset of convective instability in the thermal entrance region of plane Poiseuille flow heated uniformly from below, Int. J. Heat Mass Transfer 46 (14) (2003) 2629–2636.

[156] T. Furukawa, W.J. Yang, Thermal optimization of channel flows with discrete heating sections, J. Non-Equilibrium Thermodynam. 28 (4) (2003) 299–310.

[157] B. Freeze, S. Smolentsev, N. Morley, M. Abdou, Characterization of the effect of Froude number on surface waves and heat transfer in inclined turbulent open channel water flows, Int. J. Heat Mass Transfer 46 (20) (2003) 3765–3775.

[158] S.Y. Chung, H.J. Sung, Direct numerical simulation of turbulent concentric annular pipe flow—Part 2: Heat transfer, Int. J. Heat Fluid Flow 24 (3) (2003) 399–411.

[159] S.G. Kandlikar, W.J. Grande, Evolution of microchannel flow passages—thermohydraulic performance and fabrication technology, Heat Transfer Eng. 24 (2003) 3–17.

[160] G. Hetsroni, A. Mosyak, Z. Segal, E. Pogrebnyak, Two-phase flow patterns in parallel micro-channels, Int. J. Multiphase Flow 29 (3) (2003) 341–360.

[161] B.M. Li, D.Y. Kwok, A lattice Boltzmann model for electrokinetic microchannel flow of electrolyte solution in the presence of external forces with the Poisson-Boltzmann equation, Int. J. Heat Mass Transfer 46 (22) (2003) 4235–4244.

[162] D. Maynes, B.W. Webb, Fully developed electro-osmotic heat transfer in microchannels, Int. J. Heat Mass Transfer 46 (8) (2003) 1359–1369.

[163] D. Maynes, B.W. Webb, Fully-developed thermal transport in combined pressure and electro-osmotically driven flow in microchannels, J. Heat Transfer-Trans. ASME 125 (5) (2003) 889–895.

[164] C.W. Park, S.S. Kim, H.C. Cho, Y.T. Kang, Experimental correlation of falling film absorption heat transfer on micro-scale hatched tubes, Int. J. Refrig.-Rev. Int. Froid 26 (7) (2003) 758–763.

[165] K. Park, K.J. Noh, K.S. Lee, Transport phenomena in the thin-film region of a micro-channel, Int. J. Heat Mass Transfer 46 (13) (2003) 2381–2388.

[166] H.Y. Wu, P. Cheng, An experimental study of convective heat transfer in silicon microchannels with different surface conditions, Int. J. Heat Mass Transfer 46 (14) (2003) 2547–2556.

[167] Y. Asako, T.Q. Pi, S.E. Turner, M. Faghri, Effect of compressibility on gaseous flows in micro-channels, Int. J. Heat Mass Transfer 46 (16) (2003) 3041–3050.

[168] G. An, J.M. Li, B.X. Wang, Numerical simulation for laminar flow and heat transfer of gas in rectanglar micropassages with constant wall heat flux, Heat Mass Transfer 39 (10) (2003) 843–848.

[169] Z.Y. Guo, Z.X. Li, Size effect on single-phase channel flow and heat transfer at microscale, Int. J. Heat Fluid Flow 24 (3) (2003) 284–298.

[170] Z.Y. Guo, Z.X. Li, Size effect on microscale single-phase flow and heat transfer, Int. J. Heat Mass Transfer 46 (1) (2003) 149–159.

[171] H. Xue, H.M. Ji, C. Shu, Prediction of flow and heat transfer characteristics in micro-Couette flow, Microscale Thermophysical Engineering 7 (1) (2003) 51–68.

[172] M. Wang, Z.X. Li, Nonideal gas flow and heat transfer in micro- and nanochannels using the direct simulation Monte Carlo method—art. no. 046704, Phys. Rev. E 6804 (4 Part 2) (2003) 6704.

[173] H.W. Sun, M. Faghri, Effect of surface roughness on nitrogen flow in a microchannel using the direct simulation Monte Carlo method, Numer. Heat Transfer Part A-Appl. 43 (2003) 1–8.

[174] S. Roy, R. Raju, H.F. Chuang, B.A. Cruden, M. Meyyappan, Modeling gas flow through microchannels and nanopores, J. Applied Physics 93 (8) (2003) 4870–4879.

[175] J.M. MacInnes, X. Du, R.W.K. Allen, Prediction of electrokinetic and pressure flow in a microchannel T-junction, Phys. Fluids 15 (7) (2003) 1992–2005.

[176] C.P. Jen, C.Y. Wu, Y.C. Lin, Design and simulation of the micromixer with chaotic advection in twisted microchannels, Lab on a Chip 3 (2) (2003) 77–81.

[177] C.Y. Soong, S.H. Wang, Theoretical analysis of electrokinetic flow and heat transfer in a microchannel under asymmetric boundary conditions, J. Colloid Interface Science 265 (1) (2003) 202–213.

[178] T. Bello-Ochende, A. Bejan, Fitting the duct to the "body" of the convective flow, Int. J. Heat Mass Transfer 46 (10) (2003) 1693–1701.

[179] T.H. Furukawa, W.J. Yang, Thermal-fluid flow in parallel boards with heat generating blocks, Int. J. Heat Mass Transfer 46 (26) (2003) 5005–5015.

[180] H.K. Moon, T. O'Connell, R. Sharma, Heat transfer enhancement using a convex-patterned surface, J. Turbomach.-Trans. ASME 125 (2) (2003) 274–280.

[181] V. Prabhakar, G. Biswas, V. Eswaran, Numerical prediction of heat transfer in a channel with a built-in oval tube and various arrangements of the vortex generators, Numer. Heat Transfer Part A-Appl. 44 (3) (2003) 315–333.

[182] J.L. Tuh, T.F. Lin, Structure of mixed convective longitudinal vortex air flow driven by a heated circular plate embedded in the bottom of a horizontal flat duct, Int. J. Heat Mass Transfer 46 (8) (2003) 1341–1357.

[183] M.Y. Wen, K.J. Jang, C.C. Yang, Augmented heat transfer and pressure drop of strip-type inserts in the small tubes, Heat Mass Transfer 40 (1–2) (2003) 133–141.

[184] S. Turki, H. Abbassi, S. Ben Nasrallah, Two-dimensional laminar fluid flow and heat transfer in a channel with a built-in heated square cylinder, Int. J. Therm. Sci. 42 (12) (2003) 1105–1113.

[185] K. Tatsumi, H. Iwai, K. Inaoka, K. Suzuki, Numerical analysis for heat transfer characteristics of an oblique discrete rib mounted in a square duct, Numer. Heat Transfer Part A-Appl. 44 (8) (2003) 811–831.

[186] S.W. Moon, S.C. Lau, Heat transfer between blockages with holes in a rectangular channel, J. Heat Transfer-Trans. ASME 125 (4) (2003) 587–594.

[187] S.A. Isaev, A.I. Leont'ev, Numerical simulation of vortex enhancement of heat transfer under conditions of turbulent flow past a spherical dimple on the wall of a narrow channel, High Temperat. 41 (5) (2003) 665–679.

[188] S.A. Isaev, A.I. Leontiev, N.A. Kudryavtsev, I.A. Pyshnyi, The effect of rearrangement of the vortex structure on heat transfer under conditions of increasing depth of a spherical dimple on the wall of a narrow channel, High Temperat. 41 (2) (2003) 229–232.

[189] S.H. Huang, C.H. Chun, A numerical study of turbulent flow and conjugate heat transfer in concentric annuli with moving inner rod, Int. J. Heat Mass Transfer 46 (19) (2003) 3707–3716.

[190] X.Z. Cui, K.Y. Kim, Three-dimensional analysis of turbulent heat transfer and flow through mixing vane in a subchannel of nuclear reactor, J. Nucl. Sci. Technol. 40 (10) (2003) 719–724.

[191] M.S. Hatamipour, D. Mowla, Experimental investigation of heat transfer in an air duct with an inclined heating surface, Chem. Eng. Commun. 190 (4) (2003) 508–518.

[192] R.S. Bunker, K.F. Donnellan, Heat transfer and friction factors for flows inside circular tubes with concavity surfaces, J. Turbomach.-Trans. ASME 125 (4) (2003) 665–672.

[193] S. Mahmud, A. Islam, Laminar free convection and entropy generation inside an inclined wavy enclosure, Int. J. Therm. Sci. 42 (11) (2003) 1003–1012.

[194] T. Adachi, H. Uehara, Pressure drop and heat transfer in spanwise-periodic fluted channels, Numer. Heat Transfer Part A-Appl. 43 (1) (2003) 47–64.

[195] G. Comini, C. Nonino, S. Savino, Effect of aspect ratio on convection enhancement in wavy channels, Numer. Heat Transfer Part A-Appl. 44 (1) (2003) 21–37.

[196] T. Nishimura, Y.N. Bian, Y. Matsumoto, K. Kunitsugu, Fluid flow and mass transfer characteristics in a sinusoidal wavy-walled tube at moderate Reynolds numbers for steady flow, Heat Mass Transfer 39 (3) (2003) 239–248.

[197] O. Pinazza, M. Spiga, Friction factor at low Knudsen number for the duct with sine-shaped cross-section, Int. J. Heat Fluid Flow 24 (2) (2003) 236–241.

[198] T. Astarita, G. Cardone, Convective heat transfer in a square channel with angled ribs on two opposite walls, Exp. Fluids 34 (5) (2003) 625–634.

[199] N.K. Burgess, M.M. Oliveira, P.M. Ligrani, Nusselt number behavior on deep dimpled surfaces within a channel, J. Heat Transfer-Trans. ASME 125 (1) (2003) 11–18.

[200] Q.L. Li, L.X. Ma, Z. Chen, H.J. Warnecke, Heat transfer characteristics of a tube with elliptic pin fins in crossflow of air, Heat Mass Transfer 39 (5–6) (2003) 529–533.

[201] P.M. Ligrani, G.I. Mahmood, Variable property Nusselt numbers in a channel with pin fins, J. Thermophys. Heat Transfer 17 (1) (2003) 103–111.

[202] P.K. Panigrahi, A. Tariq, Liquid crystal heat transfer measurements in a rectangular channel with solid and slit rib, J. Visualization 6 (4) (2003) 407–416.

[203] S.Y. Won, G.I. Mahmood, P.M. Ligrani, Flow structure and local Nusselt number variations in a channel with angled crossed-rib turbulators, Int. J. Heat Mass Transfer 46 (17) (2003) 3153–3166.

[204] Z.X. Yuan, W.Q. Tao, Experimental study on heat transfer in ducts with winglet disturbances, Heat Transfer Eng. 24 (2) (2003) 76–84.

[205] T.T. Wong, C.W. Leung, Z.Y. Li, W.Q. Tao, Turbulent convection of air-cooled rectangular duct with surface-mounted cross-ribs, Int. J. Heat Mass Transfer 46 (24) (2003) 4629–4638.

[206] A. Valencia, M. Sen, Unsteady flow and heat transfer in plane channels with spatially periodic vortex generators, Int. J. Heat Mass Transfer 46 (17) (2003) 3189–3199.

[207] P.K. Sarma, T. Subramanyam, P.S. Kishore, V.D. Rao, S. Kakac, Laminar convective heat transfer with twisted tape inserts in a tube, Int. J. Therm. Sci. 42 (9) (2003) 821–828.

[208] S. Ray, A.W. Date, Friction and heat transfer characteristics of flow through square duct with twisted tape insert, Int. J. Heat Mass Transfer 46 (5) (2003) 889–902.

[209] P. Majumdar, P. Deb, Computational analysis of turbulent fluid flow and heat transfer over an array of heated modules using turbulence models, Numer. Heat Transfer Part A-Appl. 43 (7) (2003) 669–692.

[210] G.I. Mahmood, P.M. Ligrani, K. Chen, Variable property and temperature ratio effects on Nusselt numbers in a rectangular channel with 45 deg angled rib turbulators, J. Heat Transfer-Trans. ASME 125 (5) (2003) 769–778.

[211] S.G. Kandlikar, S. Joshi, S.R. Tian, Effect of surface roughness on heat transfer and fluid flow characteristics at low reynolds numbers in small diameter tubes, Heat Transfer Eng. 24 (3) (2003) 4–16.

[212] H. Iacovides, G. Kelemenis, A. Raisee, Flow and heat transfer in straight cooling passages with inclined ribs on opposite walls: an experimental and computational study, Exp. Therm. Fluid Sci. 27 (3) (2003) 283–294.

[213] S.S. Hsieh, M.H. Liu, H.H. Tsai, Turbulent heat transfer and flow characteristics in a horizontal circular tube with strip-type inserts. Part II. Heat transfer, Int. J. Heat Mass Transfer 46 (5) (2003) 837–849.

[214] F. Hasim, M. Yoshida, H. Miyashita, Compound heat transfer enhancement by a combination of a helically ribbed tube with twisted tape inserts, J. Chem. Eng. Jpn. 36 (9) (2003) 1116–1122.

[215] F. Hasim, M. Yoshida, H. Miyashita, Compound heat transfer enhancement by a combination of ribbed tubes with wire coil inserts, J. Chem. Eng. Jpn. 36 (6) (2003) 647–654.

[216] P.R. Chandra, C.R. Alexander, J.C. Han, Heat transfer and friction behaviors in rectangular channels with varying number of ribbed walls, Int. J. Heat Mass Transfer 46 (3) (2003) 481–495.

[217] S.W. Ahn, Experimental studies on heat transfer in the annuli with corrugated inner tubes, KSME Int. J. 17 (8) (2003) 1226–1233.

[218] P.M. Ligrani, G.I. Mahmood, Spatially resolved heat transfer and friction factors in a rectangular channel with 45-deg angled crossed-rib turbulators, J. Turbomach.-Trans. ASME 125 (3) (2003) 575–584.

[219] R. Kiml, S. Mochizuki, A. Murata, V. Stoica, Effects of rib-induced secondary flow on heat transfer augmentation inside a circular tube, J. Enhanced Heat Transfer 10 (1) (2003) 9–20.

[220] R.G. Jia, A. Saidi, B. Sunden, Heat transfer enhancement in square ducts with V-shaped ribs, J. Turbomach.-Trans. ASME 125 (4) (2003) 788–791.

[221] M. Furukawa, Design formulas for oscillatory heat transport in open-ended tubes, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1183–1186.

[222] A.R.A. Khaled, K. Vafai, Cooling enhancements in thin films supported by flexible complex seals in the presence of ultrafine suspensions, J. Heat Transfer-Trans. ASME 125 (5) (2003) 916–925.

[223] K.I. Matveev, Energy consideration of the nonlinear effects in a Rijke tube, J. Fluids Struct. 18 (6) (2003) 783–794.

[224] C. Sert, A. Beskok, Numerical simulation of reciprocating flow forced convection in two-dimensional channels, J. Heat Transfer-Trans. ASME 125 (3) (2003) 403–412.

[225] S.A.M. Said, M.A. Habib, M.O. Iqbal, Heat transfer to pulsating turbulent flow in an abrupt pipe expansion, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 286–308.

[226] C. Phan, D.L. Holgate, G.J. Griffin, Determination of the Nusselt versus Graetz correlation for heat transfer in channels of sinusoidal cross-section, Korean J. Chem. Eng. 20 (6) (2003) 1012–1016.

[227] S.J. Yang, An arbitrary Lagrangian–Eulerian finite element method for interactions of airflow and a moving AGV in a cleanroom, Finite Elements Anal. Design 39 (5–6) (2003) 521–533.

[228] W.S. Fu, B.H. Tong, Numerical investigation of heat transfer of a heated channel with an oscillating cylinder, Numer. Heat Transfer Part A-Appl. 43 (6) (2003) 639–658.

[229] B. Zheng, C.X. Lin, M.A. Ebadian, Combined turbulent forced convection and thermal radiation in a curved pipe with uniform wall temperature, Numer. Heat Transfer Part A-Appl. 44 (2) (2003) 149–167.

[230] Y.M. Chung, P.G. Tucker, D.G. Roychowdhury, Unsteady laminar flow and convective heat transfer in a sharp 180 degrees bend, Int. J. Heat Fluid Flow 24 (1) (2003) 67–76.

[231] Y.M. Shen, C.O. Ng, H.Q. Ni, 3D numerical modeling of non-isotropic turbulent buoyant helicoidal flow and heat transfer in a curved open channel, Int. J. Heat Mass Transfer 46 (11) (2003) 2087–2093.

[232] K. Suga, M. Nagaoka, N. Horinouchi, Application of a higher order GGDH heat flux model to three-dimensional turbulent U-bend duct heat transfer, J. Heat Transfer-Trans. ASME 125 (1) (2003) 200–203.

[233] T.T. Chandratilleke, Nursubyakto, Numerical prediction of secondary flow and convective heat transfer in externally heated curved rectangular ducts, Int. J. Therm. Sci. 42 (2) (2003) 187–198.

[234] J. Zhang, L.J. Dong, L.X. Zhou, S. Nieh, Simulation of swirling turbulent flows and heat transfer in an annular duct, Numer. Heat Transfer Part A-Appl. 44 (6) (2003) 591–609.

[235] T.H. Chang, K.S. Lee, An experimental study on heat transfer characteristics with turbulent swirling flow using uniform heat flux in a cylindrical annuli, KSME Int. J. 17 (12) (2003) 2042–2052.

[236] T.H. Chang, An investigation of heat transfer characteristics of swirling flow in a 180 degrees circular section bend with uniform heat flux, KSME Int. J. 17 (10) (2003) 1520–1532.

[237] E.J. Soares, W.A.F. Naccache, P.R.S. Mendes, Heat transfer to viscoplastic materials flowing axially through concentric annuli, Int. J. Heat Fluid Flow 24 (5) (2003) 762–773.

[238] T. Shigechi, G. Davaa, S. Momoki, O. Jambal, Laminar heat transfer with viscous dissipation and fluid axial heat conduction for modified power law fluids flowing in parallel plates with one plate moving, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (4) (2003) 539–548.

[239] N. Luna, F. Mendez, E. Mar, Transient analysis of the conjugated heat transfer in circular ducts with a power-law fluid, J. Non-Newtonian Fluid Mech. 111 (2–3) (2003) 69–85.

[240] M.F. Letelier, D.A. Siginer, Secondary flows of viscoelastic liquids in straight tubes, Int. J. Solids Struct. 40 (19) (2003) 5081–5095.

[241] R. Khatyr, D. Ouldhadda, A.I. Idrissi, Viscous dissipation effects on the asymptotic behaviour of laminar forced convection for Bingham plastics in circular ducts, Int. J. Heat Mass Transfer 46 (4) (2003) 589–598.

[242] S.H. Hashemabadi, S.G. Etemad, M.R.G. Naranji, J. Thibault, Laminar flow of non-Newtonian fluid in right triangular ducts, Int. Commun. Heat Mass Transfer 30 (1) (2003) 53–60.

[243] P.M. Coelho, F.T. Pinho, P.J. Oliveira, Thermal entry flow for a viscoelastic fluid: the Graetz problem for the PTT model, Int. J. Heat Mass Transfer 46 (20) (2003) 3865–3880.

[244] J.R. Herrera-Velarde, R. Zenit, B. Mena, Measurement of the temperature rise in non-Newtonian oscillatory pipe flows, J. Non-Newtonian Fluid Mech. 109 (2–3) (2003) 157–176.

[245] D. Erickson, D. Sinton, D.Q. Li, Joule heating and heat transfer in poly(dimethylsiloxane) microfluidic systems, Lab Chip 3 (3) (2003) 141–149.

[246] S. Bhattacharyya, S. Mahapatra, Flow and heat transfer around a surface-mounted blunt obstacle, Numer. Heat Transfer Part A-Appl. 43 (5) (2003) 465–479.

[247] G. Comini, G. Croce, Numerical simulation of convective heat and mass transfer in banks of tubes, Int. J. Numer. Methods Eng. 57 (12) (2003) 1755–1773.

[248] H. Nakamura, T. Igarashi, T. Tsutsui, Local heat transfer around a wall-mounted cube at 45 degrees to flow in a turbulent boundary layer, Int. J. Heat Fluid Flow 24 (6) (2003) 807–815.

[249] R. Nazar, N. Amin, I. Pop, Mixed convection boundary-layer flow from a horizontal circular cylinder in micropolar fluids: case of constant wall temperature, Int. J. Numer. Methods Heat Fluid Flow 13 (1) (2003) 86–109.

[250] P. Saikrishnan, S. Roy, Non-uniform slot injection (suction) into water boundary layers over (i) a cylinder and (ii) a sphere, Int. J. Engineering Science 41 (12) (2003) 1351–1365.

[251] V.I. Terekhov, N.I. Yarygina, R.F. Zhdanov, Heat transfer in turbulent separated flows in the presence of high free-stream turbulence, Int. J. Heat Mass Transfer 46 (23) (2003) 4535–4551.

[252] A. Valencia, R. Paredes, Laminar flow and heat transfer in confined channel flow past square bars arranged side by side, Heat Mass Transfer 39 (8–9) (2003) 721–728.

[253] J.M. Shi, D. Gerlach, M. Breuer, F. Durst, C.F. Lange, Analysis of heat transfer from single wires close to walls, Phys. Fluids 15 (4) (2003) 908–921.

[254] M. Sabanca, F. Durst, Flows past a tiny circular cylinder at high temperature ratios and slight compressible effects on the vortex shedding, Phys. Fluids 15 (7) (2003) 1821–1829.

[255] A. Pantokratoras, Laminar assisting mixed convection heat transfer from a vertical isothermal cylinder moving in water at low temperatures, Heat Mass Transfer 39 (8–9) (2003) 737–743.

[256] M.J. Hayne, D.J. Mee, R.G. Morgan, S.L. Gai, T.J. McIntyre, Heat transfer and flow behind a step in high enthalpy superorbital flow, Aeronaut. J. 107 (1073) (2003) 435–442.

[257] D'S.J.D. Alessio, M.G. Saunders, D.L. Harmsworth, Forced and mixed convective heat transfer from accelerated flow past an elliptic cylinder, Int. J. Heat Mass Transfer 46 (16) (2003) 2927–2946.

[258] A.I. Borodin, Controlled heat transfer in a laminar boundary layer along the penetrable surface of a blunt body, High Temperat. 41 (3) (2003) 372–376.

[259] B.A.K. Abu-Hijleh, Enhanced forced convection heat transfer from a cylinder using permeable fins, J. Heat Transfer-Trans. ASME 125 (5) (2003) 804–811.

[260] F. Gori, L. Bossi, Optimal slot height in the jet cooling of a circular cylinder, Appl. Therm. Eng. 23 (7) (2003) 859–870.

[261] S.Y. Yoo, J.H. Park, C.H. Chung, M.K. Chung, An experimental study on heat/mass transfer from a rectangular cylinder, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1163–1169.

[262] H.P. Rani, R. Devaraj, Numerical solution of unsteady flow past a vertical cylinder with temperature oscillations, Forsch. Ingenieurwes.-Eng. Res. 68 (2) (2003) 75–78.

[263] B. Paliwal, A. Sharma, R.P. Chhabra, V. Eswaran, Power law fluid flow past a square cylinder: momentum and heat transfer characteristics, Chem. Eng. Sci. 58 (23–24) (2003) 5315–5329.

[264] A.K. Gupta, A. Sharma, R.P. Chhabra, V. Eswaran, Two-dimensional steady flow of a power-law fluid past a square cylinder in a plane channel: momentum and heat-transfer characteristics, Indus. Eng. Chem. Res. 42 (22) (2003) 5674–5686.

[265] P. Ganesan, P. Loganathan, Magnetic field effect on a moving vertical cylinder with constant heat flux, Heat Mass Transfer 39 (5–6) (2003) 381–386.

[266] S. Komarov, M. Hirasawa, Enhancement of gas phase heat transfer by acoustic field application, Ultrasonics 41 (4) (2003) 289–293.

[267] B. Han, R.J. Goldstein, Instantaneous energy separation in a free jet—Part II. Total temperature measurement, Int. J. Heat Mass Transfer 46 (21) (2003) 3983–3990.

[268] N. Dukhan, K.J. De Witt, K.C. Masiulaniec, G.J. Van Fossen, Experimental Frossling numbers for ice-roughened NACA 0012 airfoils, J. Aircraft 40 (6) (2003) 1161–1167.

[269] P. de la Calzada, A. Alonso, Numerical investigation of heat transfer in turbine cascades with separated flows, J. Turbomach.-Trans. ASME 125 (2) (2003) 260–266.

[270] A. Bouhadji, N. Djilali, Forcing of unsteady separated flow and convective heat transfer via bulk upstream oscillations, Int. J. Heat Fluid Flow 24 (2003) 77–90.

[271] V.A.F. Costa, Unified streamline, heatline and massline methods for the visualization of two-dimensional heat and mass transfer in anisotropic media, Int. J. Heat Mass Transfer 46 (8) (2003) 1309–1320.

[272] A. Bejan, Simple methods for convection in porous media: scale analysis and the intersection of asymptotes, Int. J. Energy Res. 27 (10) (2003) 859–874.

[273] N. Rudraiah, P.G. Siddheshwar, T. Masuoka, Nonlinear convection in porous media: a review, J. Porous Media 6 (1) (2003) 1–32.

[274] Y.A. Zeigarnik, F.P. Ivanov, The ineffectiveness of using a universal geometric dimension in describing the hydrodynamics and heat transfer in porous structures, High Temperat. 41 (6) (2003) 807–812.

[275] D. Hansen, A review of terminology pertaining to Darcy's law and flow through porous media, J. Porous Media 6 (2) (2003) 83–97.

[276] B.M. Yu, J.H. Li, Z.H. Li, M.Q. Zou, Permeabilities of unsaturated fractal porous media, Int. J. Multiphase Flow 29 (10) (2003) 1625–1642.

[277] J.G. Fourie, J.P. Du Plessis, A two-equation model for heat conduction in porous media—II: Application, Transport Porous Media 53 (2) (2003) 163–174.

[278] A. Younes, On modelling the multidimensional coupled fluid flow and heat or mass transport in porous media, Int. J. Heat Mass Transfer 46 (367–379) (2003).

[279] R.S. Jadhav, K.M. Pillai, Numerical study of heat transfer during unsaturated flow in dual-scale porous media, Numer. Heat Transfer Part A-Appl. 43 (4) (2003) 385–407.

[280] J.J. Valencia-Lopez, G. Espinosa-Paredes, J.A. Ochoa-Tapia, Mass transfer jump condition at the boundary between a porous medium and a homogeneous fluid, J. Porous Media 6 (1) (2003) 33–49.

[281] S. Polesek-Karczewska, Effective thermal conductivity of packed beds of spheres in transient heat transfer, Heat Mass Transfer 39 (5–6) (2003) 375–380.

[282] M. Gupta, J. Yang, C. Roy, Specific heat and thermal conductivity of softwood bark and softwood char particles, Fuel 82 (8) (2003) 919–927.

[283] J.G. Fourie, J.P. Du Plessis, A two-equation model for heat conduction in porous media—I: Theory, Transport Porous Media 53 (2) (2003) 145–161.

[284] G. Buonanno, A. Carotenuto, G. Giovinco, N. Massarotti, Experimental and theoretical modeling of the effective thermal conductivity of rough steel spheroid packed beds, J. Heat Transfer-Trans. ASME 125 (4) (2003) 693–702.

[285] J.H. Nam, M. Kaviany, Effective diffusivity and water-saturation distribution in single- and two-layer PEMFC diffusion medium, Int. J. Heat Mass Transfer 46 (24) (2003) 4595–4611.

[286] M. Deleglise, P. Simacek, C. Binetruy, S. Advani, Determination of the thermal dispersion coefficient during radial filling of a porous medium, J. Heat Transfer-Trans. ASME 125 (5) (2003) 875–880.

[287] K. Daryabeigi, Heat transfer in high-temperature fibrous insulation, J. Thermophys. Heat Transfer 17 (1) (2003) 10–20.

[288] M. Mohammadi, P. Banks-Lee, P. Ghadimi, Determining radiative heat transfer through heterogeneous multilayer nonwoven materials, Textile Res. J. 73 (10) (2003) 896–900.

[289] E.I. Smirnov, A.V. Muzykantov, V.A. Kuzmin, A.E. Kronberg, I.A. Zolotarskii, Radial heat transfer in packed beds of spheres, cylinders and Rashig rings—Verification of model with a linear variation of lambda(er) in the vicinity of the wall, Chem. Eng. J. 91 (2–3) (2003) 243–248.

[290] T. Gambaryan-Roisman, M. Shapiro, E. Litovsky, A. Shavit, Influence of gas emission on heat transfer in porous ceramics, Int. J. Heat Mass Transfer 46 (2003) 385–397.

[291] N.C. Gallego, J.W. Klett, Carbon foams for thermal management, Carbon 41 (7) (2003) 1461–1466.

[292] I.A. Hassanien, A.A. Salama, A.M. Elaiw, Variable permeability effect on vortex instability of mixed convection flow in a semi-infinite porous medium bounded by a horizontal surface, Appl. Math. Comput. 146 (2–3) (2003) 829–847.

[293] J.Z. Zhao, T.S. Chen, Non-Darcy effects on nonparallel thermal instability of horizontal natural convection flow, J. Thermophys. Heat Transfer 17 (2) (2003) 150–158.

[294] D.A.S. Rees, I. Pop, The effect of large-amplitude g-jitter vertical free convection boundary-layer flow in porous media, Int. J. Heat Mass Transfer 46 (6) (2003) 1097–1102.

[295] R.A. Silva, M.J.S. de Lemos, Numerical analysis of the stress jump interface condition for laminar flow over a porous layer, Numer. Heat Transfer Part A-Appl. 43 (6) (2003) 603–617.

[296] M.P. Sobera, C.R. Kleijn, H.E.A. Van den Akker, P. Brasser, Convective heat and mass transfer to a cylinder sheathed by a porous layer, AIChE J. 49 (12) (2003) 3018–3028.

[297] S.Y. Kim, J.W. Paek, B.H. Kang, Thermal performance of aluminum-foam heat sinks by forced air cooling, IEEE Trans. Compon. Packag. Technol. 26 (1) (2003) 262–267.

[298] G. Degan, S. Zohoun, P. Vasseur, Buoyant plume above a line source of heat in an anisotropic porous medium, Heat Mass Transfer 39 (3) (2003) 209–213.

[299] R.S.R. Gorla, M. Kumari, Free convection in non-Newtonian fluids along a horizontal plate in a porous medium, Heat Mass Transfer 39 (2) (2003) 101–106.

[300] C. Wang, S.J. Liao, J.M. Zhu, An explicit solution for the combined heat and mass transfer by natural convection from a vertical wall in a non-Darcy porous medium, Int. J. Heat Mass Transfer 46 (25) (2003) 4813–4822.

[301] M.F. El-Amin, M.A. El-Hakiem, M.A. Mansour, Effects of viscous dissipation on a power-law fluid over plate embedded in a porous medium, Heat Mass Transfer 39 (10) (2003) 807–813.

[302] E. Magyari, I. Pop, B. Keller, Effect of viscous dissipation on the Darcy forced-convection flow past a plane surface, J. Porous Media 6 (2) (2003) 111–122.

[303] R.C. Chaudhary, P.K. Sharma, Three dimensional unsteady convection and mass transfer flow through porous medium, Heat Mass Transfer 39 (8–9) (2003) 765–770.

[304] D.A.S. Rees, Vertical free convective boundary-layer flow in a porous medium using a thermal nonequilibrium model: elliptical effects, Z. Angew. Math. Phys. 54 (3) (2003) 437–448.

[305] K. Vajravelu, J.R. Cannon, J. Leto, R. Semmoum, S. Nathan, A. Draper, D. Hammock, Nonlinear convection at a porous flat plate with application to heat transfer from, J. Math. Anal. Appl. 277 (2) (2003) 609–623.

[306] L. Martinez-Suastegui, C. Trevino, F. Mendez, Natural convection in a vertical strip immersed in a porous medium, Eur. J. Mech. B-Fluids 22 (6) (2003) 545–553.

[307] A.Z. Vaszi, L. Elliott, D.B. Ingham, I. Pop, Conjugate free convection from vertical fins embedded in a porous medium, Numer. Heat Transfer Part A-Appl. 44 (7) (2003) 743–770.

[308] R.K. Deka, V.M. Soundalgekar, Heat transfer in a micropolar fluid through a porous medium with variable plate temperature, J. Chin. Inst. Chem. Eng. 34 (4) (2003) 493–496.

[309] R. Nazar, N. Amin, D. Filip, I. Pop, The Brinkman model for the mixed convection boundary layer flow past a horizontal circular cylinder in a porous medium, Int. J. Heat Mass Transfer 46 (17) (2003) 3167–3178.

[310] D.A.S. Rees, A.P. Bassom, I. Pop, Forced convection past a heated cylinder in a porous medium using a thermal nonequilibrium model: boundary layer analysis, Eur. J. Mech. B-Fluids 22 (5) (2003) 473–486.

[311] M. Asbik, R. Chaynane, H. Boushaba, B. Zeghmati, A. Khmou, Analytical investigation of forced convection film condensation on a vertical porous-layer coated surface, Heat Mass Transfer 40 (1–2) (2003) 143–155.

[312] S.C. Wang, Y.T. Yang, C.K. Chen, Effect of uniform suction on laminar filmwise condensation on a finite-size horizontal flat surface in a porous medium, Int. J. Heat Mass Transfer 46 (21) (2003) 4003–4011.

[313] S. Mahmud, R.A. Fraser, Mixed convection–radiation interaction in a vertical porous channel: entropy generation, Energy 28 (15) (2003) 1557–1577.

[314] G.M. Moatimid, Nonlinear waves on the surface of a magnetic fluid jet in porous media, Physica A-Statist. Mech. Appl. 328 (3–4) (2003) 525–544.

[315] E. Nisipeanu, P.D. Jones, Monte Carlo simulation of radiative heat transfer in coarse fibrous media, J. Heat Transfer-Trans. ASME 125 (4) (2003) 748–752.

[316] K. Sundaravadivelu, C.P. Tso, Influence of viscosity variations on the forced convection flow through two types of heterogeneous porous media with isoflux boundary condition, Int. J. Heat Mass Transfer 46 (13) (2003) 2329–2339.

[317] P. Magnico, Hydrodynamic and transport properties of packed beds in small tube-to-sphere diameter ratio: pore scale simulation using an Eulerian and a Lagrangian approach, Chem. Eng. Sci. 58 (22) (2003) 5005–5024.

[318] S.J.P. Romkes, E. Dautzenberg, C.M. van den Bleek, H.P.A. Calis, CFD modelling and experimental validation of particle-to-fluid mass and heat transfer in a packed bed at very low channel to particle diameter ratio, Chem. Eng. J. 96 (1–3) (2003) 3–13.

[319] A.G. Dixon, J. Arias, J. Willey, Wall-to-liquid mass transfer in fixed beds at low flow rates, Chem. Eng. Sci. 58 (9) (2003) 1847–1857.

[320] M. Zaki, I. Nirdosh, G.H. Sedahmed, Natural convection mass transfer behaviour of vertical and horizontal cylinders embedded in an inert fixed bed of Raschig rings, Chem. Eng. Process. 42 (12) (2003) 977–984.

[321] Y.T. Yang, C.Z. Hwang, Calculation of turbulent flow and heat transfer in a porous-baffled channel, Int. J. Heat Mass Transfer 46 (5) (2003) 771–780.

[322] F. Larachi, C. Alix, B.P.A. Grandjean, A. Bernis, Nu/Sh correlation for particle–liquid heat and mass transfer coefficients in trickle beds based on Peclet similarity, Chem. Eng. Res. Design 81 (A6) (2003) 689–694.

[323] A.R. Raffray, J.E. Pulsifer, MERLOT: a model for flow and heat transfer through porous media for high heat flux applications, Fusion Eng. Design 65 (1) (2003) 57–76.

[324] G.X. Hu, W. Hu, Y.Q. Liu, Heat transfer and gas flow through feed stream within horizontal pipe, Transport Porous Media 52 (3) (2003) 371–387.

[325] P. Prinos, D. Sofialidis, E. Keramaris, Turbulent flow over and within a porous bed, J. Hydraulic Eng.-ASCE 129 (9) (2003) 720–733.

[326] G. Alvarez, P.E. Bournet, D. Flick, Two-dimensional simulation of turbulent flow and transfer through stacked spheres, Int. J. Heat Mass Transfer 46 (13) (2003) 2459–2469.

[327] M.H.J. Pedras, M.J.S. de Lemos, Computation of turbulent flow in porous media using a low-Reynolds k–ε model and an infinite array of transversally displaced elliptic rods, Numer. Heat Transfer Part A-Appl. 43 (6) (2003) 585–602.

[328] K.S. Mekheimer, Nonlinear peristaltic transport through a porous medium in an inclined planar channel, J. Porous Media 6 (3) (2003) 189–201.

[329] D. Xie, B.D. Bowen, J.R. Grace, C.J. Lim, A three-dimensional model for suspension-to-membrane-wall heat transfer in circulating fluidized beds, Chem. Eng. Sci. 58 (18) (2003) 4247–4258.

[330] D. Xie, B.D. Bowen, J.R. Grace, C.J. Lim, Two-dimensional model of heat transfer in circulating fluidized beds, Part I: Model development and validation, Int. J. Heat Mass Transfer 46 (12) (2003) 2179–2191.

[331] D. Xie, B.D. Bowen, J.R. Grace, C.J. Lim, Two-dimensional model of heat transfer in circulating fluidized beds, Part II: Heat transfer in a high density CFB and sensitivity analysis, Int. J. Heat Mass Transfer 46 (12) (2003) 2193–2205.

[332] T.J. Lin, C. Hung-Tzu, Effects of macroscopic hydrodynamics on heat transfer in a three-phase fluidized bed, Catal. Today 79 (1–4) (2003) 159–167.

[333] X.S. Wang, M.J. Rhodes, Determination of particle residence time at the walls of gas fluidized beds by discrete element method simulation, Chem. Eng. Sci. 58 (2003) 387–395.

[334] A. Dutta, P. Basu, An investigation on heat transfer to the standpipe of a circulating fluidized bed boiler, Chem. Eng. Res. Design 81 (A8) (2003) 1003–1014.

[335] M.A. Al-Busoul, S.K. Abu-Ein, Local heat transfer coefficients around a horizontal heated tube immersed in a gas fluidized bed, Heat Mass Transfer 39 (4) (2003) 355–358.

[336] S.W. Kim, J.Y. Ahn, S.D. Kim, D.H. Lee, Heat transfer and bubble characteristics in a fluidized bed with immersed horizontal tube bundle, Int. J. Heat Mass Transfer 46 (2003) 399–409.

[337] D.A. Nield, The stability of flow in a channel or duct occupied by a porous medium, Int. J. Heat Mass Transfer 46 (22) (2003) 4351–4354.

[338] D.N. Riahi, On stationary and oscillatory modes of flow instability in a rotating porous layer during alloy solidification, J. Porous Media 6 (3) (2003) 177–187.

[339] M. Mamou, Stability analysis of the perturbed rest state and of the finite amplitude steady double-diffusive convection in a shallow porous enclosure, Int. J. Heat Mass Transfer 46 (12) (2003) 2263–2277.

[340] S. Saravanan, P. Kandaswamy, Non-Darcian thermal stability of a heat generating fluid in a porous annulus, Int. J. Heat Mass Transfer 46 (25) (2003) 4863–4875.

[341] A. Mahidjiba, P. Vasseur, Linear stability of cold water layer saturating an anisotropic porous medium—effect of confinement, Int. J. Heat Mass Transfer 46 (2003) 323–332.

[342] G. Degan, P. Vasseur, Influence of anisotropy on convection in porous media with nonuniform thermal gradient, Int. J. Heat Mass Transfer 46 (5) (2003) 781–789.

[343] G. Lin, C.B. Zhao, B.E. Hobbs, A. Ord, H.B. Muhlhaus, Theoretical and numerical analyses of convective instability in porous media

with temperature-dependent viscosity, Commun. Numer. Methods Eng. 19 (10) (2003) 787–799.

[344] A. Ramanathan, P. Surendra, Effect of magnetic field on viscosity of ferroconvection in an anisotropic sparsely distributed porous medium, Indian J. Pure Appl. Phys. 41 (7) (2003) 522–526.

[345] J.P. Kubitschek, P.D. Weidman, Stability of a fluid-saturated porous medium heated from below by forced convection, Int. J. Heat Mass Transfer 46 (19) (2003) 3697–3705.

[346] A. Postelnicu, D.A.S. Rees, The onset of Darcy–Brinkman convection in a porous layer using a thermal nonequlibrium model—Part I: stress-free boundaries, Int. J. Energy Res. 27 (10) (2003) 961–973.

[347] M.C. Kim, S.B. Lee, S. Kim, B.J. Chung, Thermal instability of viscoelastic fluids in porous media, Int. J. Heat Mass Transfer 46 (26) (2003) 5065–5072.

[348] D.A. Nield, A.V. Kuznetsov, Boundary-layer analysis of forced convection with a plate and porous substrate, Acta Mech. 166 (1–4) (2003) 141–148.

[349] P. Simacek, S.G. Advani, Approximate numerical method for prediction of temperature distribution in flow through narrow gaps containing porous media, Comput. Mech. 32 (1–2) (2003) 1–9.

[350] D.A. Nield, A.V. Kuznetsov, M. Xiong, Thermally developing forced convection in a porous medium: parallel-plate channel or circular tube with walls at constant heat flux, J. Porous Media 6 (3) (2003) 203–212.

[351] M. Xiong, D.A. Nield, A. Kuznetsov, Thermally developing forced convection in a porous medium: parallel plate channel with walls at uniform temperature, with axial conduction and viscous dissipation effects, Int. J. Heat Mass Transfer 46 (2003) 643–651.

[352] A. Narasimhan, J.L. Lage, Temperature-dependent viscosity effects on the thermohydraulics of heated porous-medium channel flows, J. Porous Media 6 (3) (2003) 149–158.

[353] D.A. Nield, A.V. Kuznetsov, Effects of temperature-dependent viscosity in forced convection in a porous medium: Layered-medium analysis, J. Porous Media 6 (3) (2003) 213–222.

[354] K. Khanafer, A.J. Chamkha, Mixed convection within a porous heat generating horizontal annulus, Int. J. Heat Mass Transfer 46 (10) (2003) 1725–1735.

[355] D.A. Nield, A.V. Kuznetsov, Effects of gross heterogeneity and anisotropy in forced convection in a porous medium: layered medium analysis, J. Porous Media 6 (1) (2003) 51–57.

[356] S.Y. Kim, A.V. Kuznetsov, Optimization of pin-fin heat sinks using anisotropic local thermal nonequilibrium porous model in a jet impinging channel, Numer. Heat Transfer Part A-Appl. 44 (8) (2003) 771–787.

[357] A. Kuznetsov, L. Cheng, M. Xiong, Investigation of turbulence effects on forced convection in a composite porous/fluid duct: constant wall flux and constant wall temperature cases, Heat Mass Transfer 39 (7) (2003) 613–623.

[358] R.A. Silva, M.J.S. de Lemos, Turbulent flow in a channel occupied by a porous layer considering the stress jump at the interface, Int. J. Heat Mass Transfer 46 (26) (2003) 5113–5121.

[359] Y.H. Andoh, B. Lips, Prediction of porous walls thermal protection by effusion or transpiration cooling: an analytical approach, Appl. Therm. Eng. 23 (15) (2003) 1947–1958.

[360] T. Sheorey, K. Muralidhar, Isothermal and non-isothermal oil–water flow and viscous fingering in a porous medium, Int. J. Therm. Sci. 42 (7) (2003) 665–676.

[361] B. Wilbois, G. Galliero, J.P. Caltagirone, F. Montel, Macroscopic model of multicomponent fluids in porous media, Philos. Mag. 83 (17–18) (2003) 2209–2219.

[362] R. Torrens, L.C. Wrobel, On the propagation of a normal shock wave through a layer of incompressible porous material, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 178–198.

[363] M.A. Hossain, D.A.S. Rees, Natural convection flow of a viscous incompressible fluid in a rectangular porous cavity heated from below with cold sidewalls, Heat Mass Transfer 39 (8–9) (2003) 657–663.

[364] R. Jecl, L. Skerget, Boundary element method for natural convection in non-Newtonian fluid saturated square porous cavity, Eng. Anal. Boundary Elements 27 (10) (2003) 963–975.

[365] A.C. Baytas, Thermal non-equilibrium natural convection in a square enclosure filled with a heat-generating solid phase, non-Darcy porous medium, Int. J. Energy Res. 27 (10) (2003) 975–988.

[366] T.C. Jue, Analysis of thermal convection in a fluid-saturated porous cavity with internal heat generation, Heat Mass Transfer 40 (1–2) (2003) 83–89.

[367] J.S. Yoo, W.W. Schultz, Thermal convection in a horizontal porous layer with spatially periodic boundary temperatures: small *Ra* flow, Int. J. Heat Mass Transfer 46 (24) (2003) 4747–4750.

[368] J.S. Yoo, Thermally developing forced convection in a porous medium: parallel plate channel with walls at uniform temperature, with axial conduction and viscous dissipation effects, Int. J. Heat Mass Transfer 46 (2003) 381–384.

[369] B.V.R. Kumar, Shalini, Free convection in a non-Darcian wavy porous enclosure, Int. J. Eng. Sci. 41 (16) (2003) 1827–1848.

[370] B.V.R. Kumar, Shalini, Natural convection in a thermally stratified wavy vertical porous enclosure, Numer. Heat Transfer Part A-Appl. 43 (7) (2003) 753–776.

[371] S. Das, Y. Morsi, Natural convection in domed porous enclosures: non-Darcian flow, J. Porous Media 6 (3) (2003) 159–175.

[372] S. Kimura, Heat transfer through a vertical partition separating porous–porous or porous–fluid reservoirs at different temperatures, Int. J. Energy Res. 27 (10) (2003) 891–905.

[373] A.F. Khadrawi, M.A. Al-Nimr, The effect of the local inertial term on the free-convection fluid flow in vertical channels partially filled with porous media, J. Porous Media 6 (1) (2003) 59–70.

[374] R. Bennacer, H. Beji, A.A. Mohamad, Double diffusive convection in a vertical enclosure inserted with two saturated porous layers confining a fluid layer, Int. J. Therm. Sci. 42 (2) (2003) 141–151.

[375] R. Bennacer, A. Mahidjiba, P. Vasseur, H. Beji, R. Duval, The Soret effect on convection in a horizontal porous domain under cross temperature and concentration gradients, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 199–215.

[376] M. Benzeghiba, S. Chikh, A. Campo, Thermosolutal convection in a partly porous vertical annular cavity, J. Heat Transfer-Trans. ASME 125 (4) (2003) 703–715.

[377] M. Yoshino, T. Inamura, Lattice Boltzmann simulations for flow and heat/mass transfer problems in a three-dimensional porous structure, Int. J. Numer. Methods Fluids 43 (2) (2003) 183–198.

[378] J.L. Yuan, M. Rokni, B. Sunden, A numerical investigation of gas flow and heat transfer in proton exchange membrane fuel cells, Numer. Heat Transfer Part A-Appl. 44 (3) (2003) 255–280.

[379] I.N. Tsimpanogiannis, Y.C. Yortsos, An effective continuum model for the gas evolution in internal steam drives, SPE J. 8 (3) (2003) 262–271.

[380] F. Plourde, M. Prat, Pore network simulations of drying of capillary porous media: influence of thermal gradients, Int. J. Heat Mass Transfer 46 (7) (2003) 1293–1307.

[381] A.H. Weerts, G. Lian, D. Martin, Modeling rehydration of porous biomaterials: anisotropy effects, J. Food Sci. 68 (3) (2003) 937–942.

[382] Z. Wang, Y. Li, Q.Y. Zhu, Z.X. Luo, Radiation and conduction heat transfer coupled with liquid water transfer, moisture sorption, condensation in porous polymer materials, J. Appl. Polym. Sci. 89 (10) (2003) 2780–2790.

[383] Y. Li, Q.Y. Zhu, Simultaneous heat and moisture transfer with moisture sorption, condensation, capillary liquid diffusion in porous textiles, Textile Res. J. 73 (6) (2003) 515–524.

[384] Y. Li, Q.Y. Zhu, A model of coupled liquid moisture and heat transfer in porous textiles with consideration of gravity, Numer. Heat Transfer Part A-Appl. 43 (5) (2003) 501–523.

[385] Q.Y. Zhu, Y. Li, Effects of pore size distribution and fiber diameter on the coupled heat and liquid moisture transfer in porous textiles, Int. J. Heat Mass Transfer 46 (26) (2003) 5099–5111.

[386] A.Z. Sahin, I. Dincer, Determination of drying times for irregular two and three-dimensional objects, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1190–1193.

[387] L.B. Dantas, H.R.B. Orlande, R.M. Cotta, An inverse problem of parameter estimation for heat and mass transfer in capillary porous media, Int. J. Heat Mass Transfer 46 (9) (2003) 1587–1598.

[388] A.D. Dedic, A.S. Mujumdar, D.K. Voronjec, A three dimensional model for heat and mass transfer in convective wood drying, Dry. Technol. 21 (1) (2003) 1–15.

[389] X. Su, H. Ang, A method to solve the multilayer non-continuity problem for heat and moisture transfer in building structures, Commun. Numer. Methods Eng. 19 (12) (2003) 933–944.

[390] Y. Zhou, R.K. Rowe, Development of a technique for modelling clay liner desiccation, Int. J. Numer. Anal. Methods Geomech. 27 (6) (2003) 473–493.

[391] S. Krishnaiah, D.N. Singh, A methodology to determine soil moisture movement due to thermal gradients, Exp. Therm. Fluid Sci. 27 (6) (2003) 715–721.

[392] A. Sluzalec, Thermal waves propagation in porous material undergoing thermal loading, Int. J. Heat Mass Transfer 46 (9) (2003) 1607–1611.

[393] K.V. Prasad, S. Abel, P.S. Datti, Diffusion of chemically reactive species of a non-Newtonian fluid immersed in a porous medium over a stretching sheet, Int. J. Non-Linear Mech. 38 (2003) 651–657.

[394] I.A. Hassanien, A.H. Essawy, N.M. Moursy, Variable viscosity and thermal conductivity effects on combined heat and mass transfer in mixed convection over a UHF/UMF wedge in porous media: the entire regime, Appl. Math. Comput. 145 (2–3) (2003) 667–682.

[395] A.J. Chamkha, M. Mujtaba, A. Quadri, Simultaneous heat and mass transfer by natural convection from a plate embedded in a porous medium with thermal dispersion effects, Heat Mass Transfer 39 (7) (2003) 561–569.

[396] M. Prud'homme, S. Jasmin, Determination of a heat source in porous medium with convective mass diffusion by an inverse method, Int. J. Heat Mass Transfer 46 (11) (2003) 2065–2075.

[397] S.A. Leonardi, R. Viskanta, J.P. Gore, Analytical and experimental study of combustion and heat transfer in submerged flame metal fiber burners/heaters, J. Heat Transfer-Trans. ASME 125 (1) (2003) 118–125.

[398] S.W. Webb, N.D. Francis, S.D. Dunn, M.T. Itamura, D.L. James, Thermally induced natural convection effects in Yucca Mountain drifts, J. Contaminant Hydrol. 62-3 (Special Issue SI) (2003) 713–730.

[399] I. Pop, S.D. Harris, D.B. Ingham, S. Rhea, Three-dimensional stagnation point free convection on a reactive surface in a porous medium, Int. J. Energy Res. 27 (10) (2003) 919–939.

[400] P. Charrier, B. Dubroca, Asymptotic transport models for heat and mass transfer in reactive porous media, C. R. Math. 336 (6) (2003) 537–542.

[401] B.N. Lukyanov, V.A. Kirillov, N.A. Kuzin, M.M. Danilova, A.V. Kulikov, A.B. Shigarov, Catalytic heat generating element for autonomous domestic heating systems, Chem. Eng. J. 91 (2–3) (2003) 191–198.

[402] F. Jafar, M. Farid, Analysis of heat and mass transfer in freeze drying, Dry. Technol. 21 (2) (2003) 249–263.

[403] F. Talamucci, Freezing processes in porous media: formation of ice lenses, swelling of the soil, Math. Comput. Modell. 37 (5–6) (2003) 595–602.

[404] Y. Ogawa, Y. Yamagishi, K. Kurita, Evaluation of melting process of the permafrost on Mars: its implication for surface features—art. no. 8046, J. Geophys. Res.-Planets 108 (E4) (2003) 8046.

[405] C. Del Borrello, E. Lacoste, Numerical simulation of the liquid flow into a porous medium with phase change: application to metal matrix composites processing, Numer. Heat Transfer Part A-Appl. 44 (7) (2003) 723–741.

[406] N. Matsushima, Mathematical simulation of magma-hydrothermal activity associated with the 1977 eruption of Usu volcano, Earth Planets Space 55 (9) (2003) 559–568.

[407] C.S. Garbe, H. Spies, B. Jahne, Estimation of surface flow and net heat flux from infrared image sequences, J. Math. Imag. Vision 19 (3) (2003) 159–174.

[408] N.V. Nirmalan, R.S. Bunker, C.R. Hedlund, The measurement of full-surface internal heat transfer coefficients for turbine airfoils using a nondestructive thermal inertia technique, J. Turbomach.-Trans. ASME 125 (1) (2003) 83–89.

[409] P.J. Newton, Y.Y. Yan, N.E. Stevens, S.T. Evatt, G.D. Lock, J.M. Owen, Transient heat transfer measurements using thermochromic liquid crystal. Part 1: An improved technique, Int. J. Heat Fluid Flow 24 (1) (2003) 14–22.

[410] J.M. Owen, P.J. Newton, G.D. Lock, Transient heat transfer measurements using thermochromic liquid crystal. Part 2: Experimental uncertainties, Int. J. Heat Fluid Flow 24 (1) (2003) 23–28.

[411] G. Vogel, A.B.A. Graf, J. von Wolfersdorf, B. Weigand, A novel transient heater-foil technique for liquid crystal experiments on film-cooled surfaces, J. Turbomach.-Trans. ASME 125 (3) (2003) 529–537.

[412] D. Naylor, Recent developments in the measurement of convective heat transfer rates by laser interferometry, Int. J. Heat Fluid Flow 24 (3) (2003) 345–355.

[413] J.R. Kingsley-Rowe, G.D. Lock, A.G. Davies, Aerospace applications of luminescent paint. Part 2: Heat transfer measurement, Aeronaut. J. 107 (1077) (2003) 649–656.

[414] J.R. Kingsley-Rowe, G.D. Lock, A.G. Davies, Aerospace applications of luminescent paint. Part 1: Pressure measurement, Aeronaut. J. 107 (1077) (2003) 637–648.

[415] T. Carroll, P. Chen, A. Fletcher, A method to characterise heat transfer during high-pressure processing, J. Food Eng. 60 (2) (2003) 131–135.

[416] A.C. Chambers, D.R.H. Gillespie, P.T. Ireland, G.M. Dailey, A novel transient liquid crystal technique to determine heat transfer coefficient distributions and adiabatic wall temperature in a three-temperature problem, J. Turbomach.-Trans. ASME 125 (3) (2003) 538–546.

[417] F. Socorro, M.R. de Rivera, Changes in the transfer function of a flow microcalorimeter, J. Therm. Anal. Calorimetry 72 (1) (2003) 47–55.

[418] F. Socorro, I. de la Nuez, M.R. de Rivera, Calibration of isothermal heat conduction calorimeters: case of flow calorimeters, Measurement 33 (3) (2003) 241–250.

[419] A. Zogg, U. Fischer, K. Hungerbuhler, A new small-scale reaction calorimeter that combines the principles of power compensation and heat balance, Indus. Eng. Chem. Res. 42 (4) (2003) 767–776.

[420] C. Auguet, J. Lerchner, P. Marinelli, F. Martorell, M.R. de Rivera, V. Torra, G. Wolf, Identification of micro-scale calorimetric devices—IV. Descriptive models in 3-D, J. Therm. Anal. Calorimetry 71 (3) (2003) 951–966.

[421] B. Revaz, B.L. Zink, D. O'Neil, L. Hull, F. Hellman, Numerical simulation of the heat transfer in amorphous silicon nitride membrane-based microcalorimeters, Rev. Sci. Instrum. 74 (10) (2003) 4389–4403.

[422] T. Tszeng, V. Saraf, A study of fin effects in the measurement of temperature using surface-mounted thermocouples, J. Heat Transfer-Trans. ASME 125 (5) (2003) 926–935.

[423] M. Tagawa, K. Kato, Y. Ohta, Response compensation of thermistors: frequency response and identification of thermal time constant, Rev. Sci. Instrum. 74 (3 Part 1) (2003) 1350–1358.

[424] K. Bremhorst, S.M. Anderson, Effect of cold wire inclination on temperature fluctuation measurements in a heated jet, Exp. Therm. Fluid Sci. 27 (2) (2003) 199–206.

[425] J. Lemay, A. Benaissa, R.A. Antonia, Correction of cold-wire response for mean temperature dissipation rate measurements, Exp. Therm. Fluid Sci. 27 (2) (2003) 133–143.

[426] O. Kwon, L. Shi, A. Majumdar, Scanning thermal wave microscopy (STWM), J. Heat Transfer-Trans. ASME 125 (1) (2003) 156–163.

[427] Q. Chen, Y. Li, J.P. Longtin, Real-time laser-based measurement of interface temperature during droplet impingement on a cold surface, Int. J. Heat Mass Transfer 46 (5) (2003) 879–888.

[428] H.R. Chen, C. Gau, B.T. Dai, M.S. Tsai, A monolithic fabrication process for a micro-flow heat transfer channel suspended over an air layer with arrays of micro-sensors and heaters, Sens. Actuat. A-Phys. 108 (1–3) (2003) 81–85.
[429] D. Ruffieux, J. Joss, Influence of radiation on the temperature sensor mounted on the Swiss radiosonde, J. Atmospheric Oceanic Technol. 20 (11) (2003) 1576–1582.
[430] D.R. Buttsworth, T.V. Jones, High bandwidth stagnation temperature measurements in a Mach 6 gun tunnel flow, Exp. Therm. Fluid Sci. 27 (2) (2003) 177–186.
[431] G. Hetsroni, M. Gurevich, A. Mosyak, R. Rozenblit, Surface temperature measurement of a heated capillary tube by means of an infrared technique, Measurem. Sci. Technol. 14 (6) (2003) 807–814.
[432] D.G. Barker, M.R. Jones, Temperature measurements using a high-temperature blackbody optical fiber thermometer, J. Heat Transfer-Trans. ASME 125 (3) (2003) 471–477.
[433] Z.J. Wang, Y. Zhou, X.W. Wang, W. Jin, A fiber-optic Bragg grating sensor for simultaneous static and dynamic temperature measurement on a heated cylinder in cross-flow, Int. J. Heat Mass Transfer 46 (16) (2003) 2983–2992.
[434] J.P. Feist, A.L. Heyes, S. Seefeldt, Oxygen quenching of phosphorescence from thermographic phosphors, Measurem. Sci. Technol. 14 (5) (2003) N17–N20.
[435] S.C. Morris, J.F. Foss, Transient thermal response of a hot-wire anemometer, Measurem. Sci. Technol. 14 (3) (2003) 251–259.
[436] R.A. Antonia, On estimating mean and instantaneous turbulent energy dissipation rates with hot wires, Exp. Therm. Fluid Sci. 27 (2) (2003) 151–157.
[437] J.M. Shi, M. Breuer, F. Durst, M. Schafer, An improved numerical study of the wall effect on hot-wire measurements, J. Heat Transfer-Trans. ASME 125 (4) (2003) 595–603.
[438] F.E. Jorgensen, V.G. Chernoray, A.A. Bakchinov, L. Lofdahl, A multi-sensor hot-wire anemometer system for investigation of wall-bounded flow structures, Exp. Therm. Fluid Sci. 27 (2) (2003) 207–214.
[439] B. Johansson, C. Ljus, A.E. Almstedt, Application of wedge-shaped hot-film probes in a gas–particle flow, Exp. Therm. Fluid Sci. 27 (2) (2003) 187–191.
[440] C.S. Anderson, S.E. Semercigil, O.F. Turan, Local structural modifications for hot-wire probe design, Exp. Therm. Fluid Sci. 27 (2) (2003) 193–198.
[441] D. Meunier, S. Tardu, D. Tsamados, J. Boussey, Realization and simulation of wall shear stress integrated sensors, Microelectron. J. 34 (12) (2003) 1129–1136.
[442] K. Okamoto, J. Ota, K. Sakurai, H. Madarame, Transient velocity distributions for the supercritical carbon dioxide forced convection heat transfer, J. Nucl. Sci. Technol. 40 (10) (2003) 763–767.
[443] S. Lefevre, S. Volz, J.B. Saulnier, C. Fuentes, N. Trannoy, Thermal conductivity calibration for hot wire based dc scanning thermal microscopy, Rev. Sci. Instrum. 74 (4) (2003) 2418–2423.
[444] K. Kawashima, T. Kagawa, Unsteady flow generator for gases using an isothermal chamber, Measurement 33 (4) (2003) 333–340.
[445] A.V. Murthy, I. Wetterlund, D.P. DeWitt, Characterization of an ellipsoidal radiometer, J. Res. Nat. Inst. Stand. Technol. 108 (2) (2003) 115–124.
[446] A. Ferriere, C. Chaussavoine, J.P. Leyris, J. Hameury, Numerical simulation of the cooling of a hot disk rapidly subjected to combined convective and radiant heat losses, Int. J. Heat Mass Transfer 46 (13) (2003) 2485–2493.
[447] R. Kayikci, W.D. Griffiths, C. Strangeways, An ultrasonic technique for the determination of casting-chill contact during solidification, J. Mater. Sci. 38 (21) (2003) 4373–4378.
[448] S.M. Snyder, T. Cader, B.A. Finlayson, Finite element model of magnetoconvection of a ferrofluid, J. Magn. Magn. Mater. 262 (2) (2003) 269–279.
[449] R. Shigemitsu, T. Tagawa, H. Ozoe, Numerical computation for natural convection of air in a cubic enclosure under combination of magnetizing and gravitational forces, Numer. Heat Transfer Part A-Appl. 43 (5) (2003) 449–463.
[450] M. Akamatsu, M. Higano, Y. Takahashi, H. Ozoe, Numerical computation on the control of aerial flow by the magnetizing force in gravitational and nongravitational fields, Numer. Heat Transfer Part A-Appl. 43 (1) (2003) 9–29.
[451] T. Tagawa, A. Ujihara, H. Ozoe, Numerical computation for Rayleigh–Bénard convection of water in a magnetic field, Int. J. Heat Mass Transfer 46 (21) (2003) 4097–4104.
[452] E.M. Sparrow, J.P. Abraham, A new buoyancy model replacing the standard pseudo-density difference for internal natural convection in gases, Int. J. Heat Mass Transfer 46 (19) (2003) 3583–3591.
[453] H. Gan, J.Z. Chang, J.J. Feng, H.H. Hu, Direct numerical simulation of the sedimentation of solid particles with thermal convection, J. Fluid Mech. 481 (2003) 385–411.
[454] K. Khanafer, K. Vafai, M. Lightstone, Buoyancy-driven heat transfer enhancement in a two-dimensional enclosure utilizing nanofluids, Int. J. Heat Mass Transfer 46 (19) (2003) 3639–3653.
[455] H. Inaba, C. Dai, A. Horibe, Numerical simulation of Rayleigh–Bénard convection in non-Newtonian phase-change-material slurries, Int. J. Therm. Sci. 42 (5) (2003) 471–480.
[456] Y. Kamotani, L. Wang, S. Hatta, A. Wang, S. Yoda, Free surface heat loss effect on oscillatory thermocapillary flow in liquid bridges of high Prandtl number fluids, Int. J. Heat Mass Transfer 46 (17) (2003) 3211–3220.
[457] L. Wu, K.P. Ceh, Surface energy variation effect on the onset of thermocapillary instability of a thin liquid layer heated from the side, J. Heat Transfer-Trans. ASME 125 (1) (2003) 63–69.
[458] Y. Jiang, J.M. Floryan, Influence of heat transfer at the interface on the thermocapillary convection in the adjacent phase, J. Heat Transfer-Trans. ASME 125 (1) (2003) 190–194.
[459] V. Kumar, B. Basu, S. Enger, G. Brenner, F. Durst, Role of Marangoni convection in Si-Czochralski melts, Part I: 3D predictions without crystal, J. Crystal Growth 253 (1–4) (2003) 142–154.
[460] A. Bahloul, R. Delahaye, P. Vasseur, L. Robillard, Effect of surface tension on convection in a binary fluid layer under a zero gravity environment, Int. J. Heat Mass Transfer 46 (10) (2003) 1759–1771.
[461] M.K. Aktas, B. Farouk, Numerical simulation of developing natural convection in an enclosure due to rapid heating, Int. J. Heat Mass Transfer 46 (12) (2003) 2253–2261.
[462] H. Hirano, H. Ozoe, N. Okamoto, Experimental study of natural convection heat transfer of air in a cube below atmospheric pressure, Int. J. Heat Mass Transfer 46 (23) (2003) 4483–4488.
[463] G.B. Kim, J.M. Hyun, H.S. Kwak, Transient buoyant convection of a power-law non-Newtonian fluid in an enclosure, Int. J. Heat Mass Transfer 46 (19) (2003) 3605–3617.
[464] K.H. Kim, J.M. Hyun, Transient buoyant convection in an enclosure by sudden imposition of gravity, Numer. Heat Transfer Part A-Appl. 44 (2) (2003) 169–182.
[465] G.B. Kim, J.M. Hyun, H.S. Kwak, Enclosed buoyant convection of a variable-viscosity fluid under time-periodic thermal forcing, Numer. Heat Transfer Part A-Appl. 43 (2) (2003) 137–154.
[466] Z.J. Zhu, H.X. Yang, Numerical investigation of transient laminar natural convection of air in a tall cavity, Heat Mass Transfer 39 (7) (2003) 579–587.
[467] M. Prud'homme, H. Bougherara, A. Bahloul, Convection in a vertical cavity submitted to crossed uniform heat fluxes, Int. J. Heat Mass Transfer 46 (20) (2003) 3831–3840.
[468] D.A. Bratsun, A.V. Zyuzgin, G.F. Putin, Non-linear dynamics and pattern formation in a vertical fluid layer heated from the side, Int. J. Heat Fluid Flow 24 (6) (2003) 835–852.
[469] F. Ampofo, T.G. Karayiannis, Experimental benchmark data for turbulent natural convection in an air filled square cavity, Int. J. Heat Mass Transfer 46 (19) (2003) 3551–3572.
[470] M.A.R. Sharif, W. Liu, Numerical study of turbulent natural convection in a side-heated square cavity at various angles of inclination, Numer. Heat Transfer Part A-Appl. 43 (7) (2003) 693–716.

[471] M. Rahman, M.A.R. Sharif, Numerical study of laminar natural convection in inclined rectangular enclosures of various aspect ratios, Numer. Heat Transfer Part A-Appl. 44 (4) (2003) 355–373.

[472] Y.S. Morsi, S. Das, Numerical investigation of natural convection inside complex enclosures, Heat Transfer Eng. 24 (2) (2003) 30–41.

[473] A. Liaqat, A.C. Baytas, Numerical analysis of buoyant flow in a hemispherical enclosure at high Rayleigh numbers, Heat Mass Transfer 40 (1–2) (2003) 99–104.

[474] E.B. Soboleva, Adiabatic heating and convection caused by a fixed-heat-flux source in a near-critical fluid—art. no. 042201, Phys. Rev. E 6804 (4 Part 1) (2003) 2201.

[475] J.P. Abraham, E.M. Sparrow, Three-dimensional laminar and turbulent natural convection in a continuously/discretely wall-heated enclosure containing a thermal load, Numer. Heat Transfer Part A-Appl. 44 (2) (2003) 105–125.

[476] S.H. Chuang, J.S. Chiang, Y.M. Kuo, Numerical simulation of heat transfer in a three-dimensional enclosure with three chips in various position arrangements, Heat Transfer Eng. 24 (2) (2003) 42–59.

[477] M. Ishizuka, Y. Kitamura, Studies on natural convection-induced flow and thermal behaviour inside electronic equipment cabinet model, Proc. Inst. Mech. Eng. Part A-J. Power Energy 217 (A3) (2003) 323–328.

[478] S.K.W. Tou, X.F. Zhang, Three-dimensional numerical simulation of natural convection in an inclined liquid-filled enclosure with an array of discrete heaters, Int. J. Heat Mass Transfer 46 (1) (2003) 127–138.

[479] P.K. Das, S. Mahmud, Numerical investigation of natural convection inside a wavy enclosure, Int. J. Therm. Sci. 42 (4) (2003) 397–406.

[480] F. Moukalled, M. Darwish, Natural convection in a partitioned trapezoidal cavity heated from the side, Numer. Heat Transfer Part A-Appl. 43 (5) (2003) 543–563.

[481] M. Boussaid, A. Djerrada, M. Bouhadef, Thermosolutal transfer within trapezoidal cavity, Numer. Heat Transfer Part A-Appl. 43 (4) (2003) 431–448.

[482] N. Yucel, A.H. Ozdem, Natural convection in partially divided square enclosures, Heat Mass Transfer 40 (1–2) (2003) 167–175.

[483] V.A.F. Costa, M.S.A. Oliveira, A.C.M. Sousa, Control of laminar natural convection in differentially heated square enclosures using solid inserts at the corners, Int. J. Heat Mass Transfer 46 (18) (2003) 3529–3537.

[484] S.P. Kearney, F.V. Reyes, Quantitative temperature imaging in gas-phase turbulent thermal convection by laser-induced fluorescence of acetone, Exp. Fluids 34 (1) (2003) 87–97.

[485] C.H. Lan, O.A. Ezekoye, J.R. Howell, K.S. Ball, Stability analysis for three-dimensional Rayleigh–Bénard convection with radiatively participating medium using spectral methods, Int. J. Heat Mass Transfer 46 (8) (2003) 1371–1383.

[486] S. Torii, W.J. Yang, Evaporation-induced Bénard convection in a thin liquid layer, Int. J. Energy Res. 27 (3) (2003) 255–264.

[487] S. Aumaitre, S. Fauve, Statistical properties of the fluctuations of the heat transfer in turbulent convection, Europhys. Lett. 62 (6) (2003) 822–828.

[488] H. Inaba, C. Dai, A. Horibe, Natural convection heat transfer of microemulsion phase-change-material slurry in rectangular cavities heated from below and cooled from above, Int. J. Heat Mass Transfer 46 (23) (2003) 4427–4438.

[489] A.A. Zadorozhko, T.V. Kalko, E.Y. Rudavskskii, V.K. Chagovets, G.A. Sheshin, Convective instability of He-3–He-4 superfluid mixtures heated from below, Low Temperat. Phys. 29 (8) (2003) 619–623.

[490] H.I. Tarman, A Karhunen-Loeve-based approach to numerical simulation of transition in Rayleigh–Bénard convection, Numer. Heat Transfer B-Fundament. 43 (6) (2003) 567–586.

[491] A.A. Gubaidullin, Correlations for natural convection heat transfer in two-layer fluids with internal heat generation, Int. J. Heat Mass Transfer 46 (20) (2003) 3935–3940.

[492] A. Namiki, K. Kurita, Heat transfer and interfacial temperature of two-layered convection: implications for the D$''$-mantle coupling—art. no. 1023, Geophys. Res. Lett. 30 (1) (2003) 1023.

[493] J.C.R. Hunt, A.J. Vrieling, F.T.M. Nieuwstadt, H.J.S. Fernando, The influence of the thermal diffusivity of the lower boundary on eddy motion in convection, J. Fluid Mech. 491 (2003) 183–205.

[494] R. Verzicco, R. Camussi, Numerical experiments on strongly turbulent thermal convection in a slender cylindrical cell, J. Fluid Mech. 477 (2003) 19–49.

[495] J.J. Niemela, K.R. Sreenivasan, Thermal turbulence in cryogenic helium gas, Physica B: Condens. Matter 329 (2003) 429–430.

[496] M. Corcione, Effects of the thermal boundary conditions at the sidewalls upon natural convection in rectangular enclosures heated from below and cooled from above, Int. J. Therm. Sci. 42 (2) (2003) 199–208.

[497] R.D. Oliveski, A. Krenzinger, H.A. Vielmo, Comparison between models for the simulation of hot water storage tanks, Solar Energy 75 (2) (2003) 121–134.

[498] R.D. Oliveski, A. Krenzinger, H.A. Vielmo, Cooling of cylindrical vertical tanks submitted to natural internal convection, Int. J. Heat Mass Transfer 46 (11) (2003) 2015–2026.

[499] A. Bairi, Transient natural 2D convection in a cylindrical cavity with the upper face cooled by thermoelectric Peltier effect following an exponential law, Appl. Therm. Eng. 23 (4) (2003) 431–447.

[500] R. Verzicco, Turbulent thermal convection in a closed domain: viscous boundary layer and mean flow effects, Eur. Phys. J. B 35 (1) (2003) 133–141.

[501] S. Maki, T. Tagawa, H. Ozoe, Average heat transfer rates measured and numerically analyzed for combined convection of air in an inclined cylindrical enclosure due to both magnetic and gravitational fields, Exp. Therm. Fluid Sci. 27 (8) (2003) 891–899.

[502] Y. Zhang, T. Takeda, Y. Inaba, Experimental study on natural convection in the vertical enclosure of a double coaxial cylinder, Kerntechnik 68 (5–6) (2003) 254–258.

[503] A. Chakir, M. Souli, N. Aquelet, Study of a turbulent natural convection in cylindrical annuli of gas-insulated transmission lines 400 kV, Appl. Therm. Eng. 23 (10) (2003) 1197–1208.

[504] J.S. Yoo, Dual free-convective flows in a horizontal annulus with a constant heat flux wall, Int. J. Heat Mass Transfer 46 (13) (2003) 2499–2503.

[505] Y. Peng, Y.T. Chew, C. Shu, Numerical simulation of natural convection in a concentric annulus between a square outer cylinder and a circular inner cylinder using the Taylor-series-expansion and least-squares-based lattice Boltzmann method—art. no. 026701, Phys. Rev. E 6702 (2 Part 2) (2003) 6701.

[506] A.Y. Gelfgat, A.L. Yarin, P.Z. Bar-Yoseph, Convection-induced enhancement of mass transfer through an interface separating two immiscible liquids in a two-layer horizontal annulus, Phys. Fluids 15 (3) (2003) 790–800.

[507] K. Ichimiya, T. Abe, Impingement heat transfer of a single thermal plume on the upper wall, Int. J. Heat Mass Transfer 46 (18) (2003) 3521–3528.

[508] A.M. Jeffinek, H.M. Gonnermann, M.A. Richards, Plume capture by divergent plate motions: implications for the distribution of hotspots, geochemistry of mid-ocean ridge basalts, and estimates of the heat flux at the core-mantle boundary, Earth Planet. Sci. Lett. 205 (3–4) (2003) 361–378.

[509] J. Li, W.K. Chow, Line plume approximation on atrium smoke filling with thermal stratified environment, J. Heat Transfer-Trans. ASME 125 (2) (2003) 289–300.

[510] G.C. Buscaglia, E.A. Dari, Numerical investigation of flow through a cavity with internal heat generation, Numer. Heat Transfer Part A-Appl. 43 (5) (2003) 525–541.

[511] K.G. Gebremedhin, B. Wu, Characterization of flow field in a ventilated space and simulation of heat exchange between cows and their environment, J. Therm. Biol. 28 (4) (2003) 301–319.

[512] C. Teodosiu, G. Rusaouen, R. Hohota, Influence of boundary conditions uncertainties on the simulation of ventilated enclosures, Numer. Heat Transfer Part A-Appl. 44 (5) (2003) 483–504.

[513] M. Chacha, M.Z. Saghir, S. Van Vaerenbergh, J.C. Legros, Influence of thermal boundary conditions on the double-diffusive process in a binary mixture, Philos. Mag. 83 (17–18) (2003) 2109–2129.

[514] L. Zili-Ghedira, K. Slimi, S. Ben Nasrallah, Double diffusive natural convection in a cylinder filled with moist porous grains and exposed to a constant wall heat flux, J. Porous Media 6 (2) (2003) 123–136.

[515] R.M. Nelson, Reaction times and burning rates for wind tunnel headfires, Int. J. Wildland Fire 12 (2) (2003) 195–211.

[516] J.L. Yuan, M. Rokni, B. Sunden, Combined mass suction and buoyancy effects on heat transfer and gas flow in a fuel cell duct, Numer. Heat Transfer Part A-Appl. 43 (4) (2003) 341–366.

[517] G. Polidori, C. Popa, T.H. Mai, Transient flow rate behaviour in an external natural convection boundary layer, Mech. Res. Commun. 30 (6) (2003) 615–621.

[518] G. Polidori, J. Padet, Transient free convection flow on a vertical surface with an array of large-scale roughness elements, Exp. Therm. Fluid Sci. 27 (3) (2003) 251–260.

[519] A. Pantokratoras, Laminar free-convection in glycerol with variable physical properties adjacent to a vertical plate with uniform heat flux, Int. J. Heat Mass Transfer 46 (9) (2003) 1675–1678.

[520] A. Pantokratoras, Laminar free-convection in water with variable physical properties adjacent to a vertical plate with uniform heat flux, Int. J. Heat Mass Transfer 46 (4) (2003) 725–729.

[521] A. Pantokratoras, A note on the Nusselt number adjacent to a vertical isothermal plate immersed in thermally stratified water at low temperatures, Int. J. Heat Fluid Flow 24 (2) (2003) 278–281.

[522] R. Biertumpfel, H. Beer, Natural convection heat transfer increase at the laminar–turbulent transition in the presence of instationary longitudinal vortices, Int. J. Heat Mass Transfer 46 (16) (2003) 3109–3117.

[523] A. Pantokratoras, Effect of viscous dissipation and pressure stress work in natural convection along a vertical isothermal plate. New results, Int. J. Heat Mass Transfer 46 (25) (2003) 4979–4983.

[524] R.X. Cai, N. Zhang, Explicit analytical solutions of linear and nonlinear interior heat and mass transfer equation sets for drying process, J. Heat Transfer-Trans. ASME 125 (1) (2003) 175–178.

[525] M.Y. Gokhale, F.M. Al Samman, Effects of mass transfer on the transient free convection flow of a dissipative fluid along a semi-infinite vertical plate with constant heat flux, Int. J. Heat Mass Transfer 46 (6) (2003) 999–1011.

[526] I. Martorell, J. Herrero, F.X. Grau, Natural convection from narrow horizontal plates at moderate Rayleigh numbers, Int. J. Heat Mass Transfer 46 (13) (2003) 2389–2402.

[527] J.J. Wei, B. Yu, Y. Kawaguchi, Simultaneous natural-convection heat transfer above and below an isothermal horizontal thin plate, Numer. Heat Transfer Part A-Appl. 44 (1) (2003) 39–58.

[528] S. Pretot, J. Miriel, Y. Bailly, B. Zeghmati, Visualization and simulation of the natural-convection flow above horizontal wavy plates, Numer. Heat Transfer Part A-Appl. 43 (3) (2003) 307–325.

[529] S. Pretot, B. Zeghmati, J. Bresson, Numerical and experimental study of free convection above a sinusoidal horizontal plate, Heat Mass Transfer 39 (3) (2003) 183–194.

[530] S. Generalis, M. Nagata, Transition in homogeneously heated inclined plane parallel shear flows, J. Heat Transfer-Trans. ASME 125 (5) (2003) 795–803.

[531] P. Ganesan, G. Palani, Natural convection effects on impulsively started inclined plate with heat and mass transfer, Heat Mass Transfer 39 (4) (2003) 277–283.

[532] Y.M.C. Delaure, V.S.S. Chan, D.B. Murray, A simultaneous PIV and heat transfer study of bubble interaction with free convection flow, Exp. Therm. Fluid Sci. 27 (8) (2003) 911–926.

[533] G. Desrayaud, A. Fichera, On natural convective heat transfer in vertical channels with a single surface mounted heat-flux module, J. Heat Transfer-Trans. ASME 125 (4) (2003) 734–739.

[534] H. Gunes, Analytical solution of buoyancy-driven flow and heat transfer in a vertical channel with spatially periodic boundary conditions, Heat Mass Transfer 40 (1–2) (2003) 33–45.

[535] H. Gunes, A. Liakopoulos, Three-dimensional convective cooling in a vertical channel with flush-mounted heat sources, Int. J. Heat Mass Transfer 46 (5) (2003) 791–808.

[536] A. Bejan, Y. Fautrelle, Constructal multi-scale structure for maximal heat transfer density, Acta Mech. 163 (1–2) (2003) 39–49.

[537] O. Manca, M. Musto, V. Naso, Experimental analysis of asymmetrical isoflux channel-chimney systems, Int. J. Therm. Sci. 42 (9) (2003) 837–846.

[538] M.A. Al-Subaie, A.J. Chamkha, Analytical solutions for hydromagnetic natural convection flow of a particulate suspension through a channel with heat generation or absorption effects, Heat Mass Transfer 39 (8–9) (2003) 701–707.

[539] M. Al-Subaie, A. Chamkha, Steady natural convection flow of a particulate suspension through a parallel-plate channel, Heat Mass Transfer 39 (4) (2003) 337–343.

[540] Y. Ohya, T. Uchida, Turbulence structure of stable boundary layers with a near-linear temperature profile, Bound.-Lay. Meteorol. 108 (1) (2003) 19–38.

[541] R.H. Nilson, S.K. Griffiths, Natural convection in trenches of high aspect ratio, J. Electrochem. Soc. 150 (6) (2003) C401–C412.

[542] T. Suekane, M. Sekiguchi, S. Hirai, T. Okamura, Heat transfer and flown of HeII in narrow channels, Cryogenics 43 (2) (2003) 125–131.

[543] J. Cadafalch, A. Oliva, G. van der Graaf, X. Albets, Natural convection in a large, inclined channel with asymmetric heating and surface radiation, J. Heat Transfer-Trans. ASME 125 (5) (2003) 812–820.

[544] O. Polat, E. Bilgen, Conjugate heat transfer in inclined open shallow cavities, Int. J. Heat Mass Transfer 46 (9) (2003) 1563–1573.

[545] E.M.A. Mokheimer, Heat transfer from extended surfaces subject to variable heat transfer coefficient, Heat Mass Transfer 39 (2) (2003) 131–138.

[546] M. Mobedi, H. Yuncu, A three dimensional numerical study on natural convection heat transfer from short horizontal rectangular fin array, Heat Mass Transfer 39 (4) (2003) 267–275.

[547] B.A.K. Abu-Hijleh, Natural convection heat transfer from a cylinder with high conductivity permeable fins, J. Heat Transfer-Trans. ASME 125 (2) (2003) 282–288.

[548] B.A.K. Abu-Hijleh, Optimization of natural convection heat transfer from a cylinder with high conductivity fins, Numer. Heat Transfer Part A-Appl. 43 (1) (2003) 65–82.

[549] B.A.K. Abu-Hijleh, Optimized use of baffles for reduced natural convection heat transfer from a horizontal cylinder, Int. J. Therm. Sci. 42 (11) (2003) 1061–1071.

[550] D. Ambrosini, D. Paoletti, G.S. Spagnolo, Study of free-convective onset on a horizontal wire using speckle pattern interferometry, Int. J. Heat Mass Transfer 46 (22) (2003) 4145–4155.

[551] M.-C. Duluc, S. Xin, P. LeQuere, Transient natural convection and conjugate transients around a line heat source, Int. J. Heat Mass Transfer 46 (2) (2003) 341–354.

[552] M.A. Atmane, V.S.S. Chan, D.B. Murray, Natural convection around a horizontal heated cylinder: the effects of vertical confinement, Int. J. Heat Mass Transfer 46 (19) (2003) 3661–3672.

[553] F.M. Mahfouz, Transient free convection from a horizontal cylinder placed in a micropolar fluid, Heat Mass Transfer 39 (5–6) (2003) 455–462.

[554] S.C. Haldar, Conjugate analysis of heat transfer from a horizontal insulated cylinder, Int. Commun. Heat Mass Transfer 30 (1) (2003) 139–147.

[555] F.M. Mahfouz, S. Kocabiyik, Transient numerical simulation of buoyancy driven flow adjacent to an elliptic tube, Int. J. Heat Fluid Flow 24 (6) (2003) 864–873.

[556] J.L. Munoz-Cobo, J.M. Corberan, S. Chiva, Explicit formulas for laminar natural convection heat transfer along vertical cylinders with power-law wall temperature distribution, Heat Mass Transfer 39 (3) (2003) 215–222.

[557] W.M. Lewandowski, S. Leble, Study of free convective heat transfer from horizontal conic, Int. J. Heat Mass Transfer 46 (25) (2003) 4925–4934.

[558] F.J. Diez, R. Sangras, G.M. Faeth, O.C. Kwon, Self-preserving properties of unsteady round buoyant turbulent plumes and thermals in still fluids, J. Heat Transfer-Trans. ASME 125 (5) (2003) 821–830.

[559] F.J. Diez, L.P. Bernal, G.M. Faeth, Round turbulent thermals, puffs, starting plumes and starting jets in uniform crossflow, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1046–1057.

[560] B.X. Chen, Y.C. Song, M. Nishio, M. Akai, Large-eddy simulation of double-plume formation induced by CO2 dissolution in the ocean, Tellus Ser. B-Chem. Phys. Meteorol. 55 (2) (2003) 723–730.

[561] C.P. Brescianini, M.A. Delichatsios, New evaluation of the k–ε turbulence model for free buoyant plumes, Numer. Heat Transfer Part A-Appl. 43 (7) (2003) 731–751.

[562] H.V. Raju, R. Narasimha, Limiting cross-flow velocity below which heat flux is determined by natural convection laws, Int. J. Heat Mass Transfer 46 (25) (2003) 4975–4978.

[563] M. Mosaad, A. Ben-Nakhi, Conjugate parallel-flowing free and forced convection boundary layers on vertical wall sides, Heat Mass Transfer 39 (3) (2003) 177–182.

[564] S.A. Al-Sanea, Convection regimes and heat transfer characteristics along a continuously moving heated vertical plate, Int. J. Heat Fluid Flow 24 (6) (2003) 888–901.

[565] K. Kudo, T. Kato, H. Chida, S. Takagi, N. Tsui, Modelling of combined forced- and natural-convection heat transfer over upward-facing horizontal heated flat plates, Int. J. Energy Res. 27 (4) (2003) 327–335.

[566] H.S. Takhar, A.J. Chamkha, G. Nath, Natural convection on a thin vertical cylinder moving in a high-porosity ambient medium, Int. J. Eng. Sci. 41 (16) (2003) 1935–1950.

[567] A. Kumar, A. Mahurkar, A. Joshi, Study of the spread of a cold instantaneous heavy gas release with surface heat transfer and variable entrainment, J. Hazard. Mater. 101 (2) (2003) 157–177.

[568] J.W. Jeong, S.A. Mumma, Impact of mixed convection on ceiling radiant cooling panel capacity, Hvac&R Res. 9 (3) (2003) 251–257.

[569] T.F. Lin, Buoyancy driven vortex flow and thermal structures in a very low Reynolds number mixed convective gas flow through a horizontal channel, Int. J. Heat Fluid Flow 24 (3) (2003) 299–309.

[570] E. Kehoe, M. Davies, D. Newport, Mixed convection cooling of horizontally mounted printed circuit board, IEEE Trans. Compon. Packag. Technol. 26 (1) (2003) 126–133.

[571] A. Appukuttan, W. Shyy, M. Sheplak, L. Cattafesta, Mixed convection induced by MEMS-based thermal shear stress sensors, Numer. Heat Transfer Part A-Appl. 43 (3) (2003) 283–305.

[572] J.C. Hsieh, T.C. Cheng, T.F. Lin, Characteristics of vortex flow in a low speed air jet impinging onto a heated disk in a vertical cylindrical chamber, Int. J. Heat Mass Transfer 46 (24) (2003) 4639–4656.

[573] O. Manca, S. Nardini, K. Khanafer, K. Vafai, Effect of heated wall position on mixed convection in a channel with an open cavity, Numer. Heat Transfer Part A-Appl. 43 (3) (2003) 259–282.

[574] L.C. Fang, Effect of mixed convection on transient hydrodynamic removal of a contaminant from a cavity, Int. J. Heat Mass Transfer 46 (11) (2003) 2039–2049.

[575] J. You, J.Y. Yoo, H. Choi, Direct numerical simulation of heated vertical air flows in fully developed turbulent mixed convection, Int. J. Heat Mass Transfer 46 (9) (2003) 1613–1627.

[576] D.D. Joye, Pressure drop correlation for laminar, mixed convection, aiding flow heat transfer in a vertical tube, Int. J. Heat Fluid Flow 24 (2) (2003) 260–266.

[577] M.M.S. El-Din, Effect of thermal and mass buoyancy forces on the development of laminar mixed convection between vertical parallel plates with uniform wall heat and mass fluxes, Int. J. Therm. Sci. 42 (5) (2003) 447–453.

[578] S. Kasbioui, E.K. Lakhal, M. Hasnaoui, Mixed convection in rectangular enclosures with adiabatic fins attached on the heated wall, Eng. Comput. (Swansea, Wales) 20 (1–2) (2003) 152–177.

[579] M. Feddaoui, A. Mir, E. Belahmidi, Numerical simulation of mixed convection heat and mass transfer with liquid film cooling along an insulated vertical channel, Heat Mass Transfer 39 (5–6) (2003) 445–453.

[580] A. Barletta, E.R. di Schio, E. Zanchini, Combined forced and free flow in a vertical rectangular duct with prescribed wall heat flux, Int. J. Heat Fluid Flow 24 (6) (2003) 874–887.

[581] S. Kazansky, V. Dubovsky, G. Ziskind, R. Letan, Chimney-enhanced natural convection from a vertical plate: experiments and numerical simulations, Int. J. Heat Mass Transfer 46 (3) (2003) 497–512.

[582] A. Barletta, E. Zanchini, Time-periodic laminar mixed convection in an inclined channel, Int. J. Heat Mass Transfer 46 (3) (2003) 551–563.

[583] R. Gruber, T. Melin, Mixed convection in the copper dissolution technique of studying mass transfer, Int. J. Heat Mass Transfer 46 (13) (2003) 2403–2413.

[584] H. Abbassi, M. Magherbi, A. Ben Brahim, Entropy generation in Poiseuille–Bénard channel flow, Int. J. Therm. Sci. 42 (12) (2003) 1081–1088.

[585] M. Cruchaga, D. Celentano, Modelling natural and mixed convection in obstructed channels, Int. J. Numer. Methods Heat Fluid Flow 13 (1) (2003) 57–85.

[586] M. Najam, A. Amahmid, M. Hasnaoui, M. El Alami, Unsteady mixed convection in a horizontal channel with rectangular blocks periodically distributed on its lower wall, Int. J. Heat Fluid Flow 24 (5) (2003) 726–735.

[587] E. Radziemska, W.M. Lewandowski, Natural convective heat transfer from isothermal cuboids, Int. J. Heat Mass Transfer 46 (12) (2003) 2169–2178.

[588] Y.W. Zhang, Quasi-steady state natural convection in laser chemical vapor deposition with a moving laser beam, J. Heat Transfer-Trans. ASME 125 (3) (2003) 429–437.

[589] B.N. Antar, M.S. Paley, W.K. Witherow, Experimental and numerical investigation of buoyancy driven convection during PDAMNA thin film growth, J. Crystal Growth 250 (3–4) (2003) 565–582.

[590] H. Ohira, Numerical simulation of aerosol behavior in turbulent natural convection—verification of an advanced model, J. Nucl. Sci. Technol. 40 (5) (2003) 307–316.

[591] I. Mogi, C. Umeki, K. Takahashi, S. Awaji, K. Watanabe, M. Motokawa, Control of thermal convection in water by strong gradient magnetic fields, Jpn. J. Appl. Phys. Part 2-Lett. 42 (6B) (2003) L715–L717.

[592] B. Sitte, H.J. Rath, Influence of the dielectrophoretic force on thermal convection, Exp. Fluids 34 (1) (2003) 24–27.

[593] M. Magherbi, H. Abbassi, A. Ben Brahim, Entropy generation at the onset of natural convection, Int. J. Heat Mass Transfer 46 (18) (2003) 3441–3450.

[594] C.Y. Soong, T.P. Liu, C.C. Wu, Dynamical responses of non-isothermal flow between two independently rotating disks with time-dependent wall conditions, Heat Mass Transfer 39 (8–9) (2003) 753–764.

[595] G.M. Sisoev, O.K. Matar, C.J. Lawrence, Modelling of film flow over a spinning disk, J. Chem. Technol. Biotechnol. 78 (2–3) (2003) 151–155.

[596] H.A. Attia, Unsteady flow of a non-Newtonian fluid above a rotating disk with heat transfer, Int. J. Heat Mass Transfer 46 (14) (2003) 2695–2700.

[597] M. Kumari, G. Nath, Nonsimilar boundary-layer flow over a stationary permeable plate in a rotating fluid with a magnetic field, Arch. Appl. Mech. 72 (10) (2003) 730–744.

[598] A.S. Gupta, J.C. Misra, M. Reza, V.M. Soundalgekar, Flow in the Ekman layer on an oscillating porous plate, Acta Mech. 165 (1–2) (2003) 1–16.

[599] H.S. Takhar, A.J. Chamkha, G. Nath, Flow and heat transfer on a stretching surface in a rotating fluid with a magnetic field, Int. J. Therm. Sci. 42 (1) (2003) 23–31.

[600] H.H. Cho, C.H. Won, G.Y. Ryu, D.H. Rhee, Local heat transfer characteristics in a single rotating disk and co-rotating disks, Microsyst. Technol. 9 (6–7) (2003) 399–408.

[601] Z.X. Yuan, N. Saniei, X.T. Yan, Turbulent heat transfer on the stationary disk in a rotor–stator system, Int. J. Heat Mass Transfer 46 (12) (2003) 2207–2218.

[602] V. Oravsky, Heat transfer from an ESF radial plate clutch surface. Part II—Theory, J. Intell. Mater. Syst. Struct. 14 (2) (2003) 125–129.

[603] D.M. Kremer, R.W. Davis, E.F. Moore, J.E. Maslar, D.R. Burgess, S.H. Ehrman, An investigation of particle dynamics in a rotating disk chemical vapor deposition reactor, J. Electrochem. Soc. 150 (2) (2003) G127–G139.

[604] B. Ozar, B.M. Cetegen, A. Faghri, Experiments on the flow of a thin liquid film over a horizontal stationary and rotating disk surface, Exp. Fluids 34 (5) (2003) 556–565.

[605] J.S. Zhang, B.H. Zhang, Dean equations extended to a rotating helical pipe flow, J. Eng. Mech.-ASCE 129 (7) (2003) 823–829.

[606] H.J. Chen, B.Z. Zhang, J.F. Ma, Theoretical and numerical analysis of convective heat transfer in the rotating helical pipes, Int. J. Heat Mass Transfer 46 (25) (2003) 4899–4909.

[607] H.J. Chen, B.Z. Zhang, Fluid flow and mixed convection heat transfer in a rotating curved pipe, Int. J. Therm. Sci. 42 (11) (2003) 1047–1059.

[608] T.M. Liou, C.C. Chen, M.Y. Chen, Rotating effect on fluid flow in two smooth ducts connected by a 180-degree bend, J. Fluids Eng.-Trans. ASME 125 (1) (2003) 138–148.

[609] S.S. Hsieh, J.T. Huang, H.H. Tsai, Impingement cooling in a rotating curved square annular duct with crossflow effect from rib-roughened surfaces, Heat Mass Transfer 39 (2) (2003) 107–117.

[610] I. Raspo, E.C. del Arco, Instability in a rotating channel-cavity system with an axial through-flow, Int. J. Heat Fluid Flow 24 (1) (2003) 41–53.

[611] Y. Okita, H. Iacovides, Comparisons of high-Reynolds-number EVM and DSM models in the prediction of heat and fluid flow of turbine blade cooling passages, J. Turbomach.-Trans. ASME 125 (3) (2003) 585–597.

[612] Y. Nagano, H. Hattori, Direct numerical simulation and modelling of spanwise rotating channel flow with heat transfer—art. no. 010, J. Turbulence 4 (10) (2003) 28.

[613] P. Agarwal, S. Acharya, D.E. Nikitopoulos, Heat transfer in 1:4 rectangular passages with rotation, J. Turbomach.-Trans. ASME 125 (4) (2003) 726–733.

[614] L. Al-Hadhrami, T. Griffith, J.C. Han, Heat transfer in two-pass rotating rectangular channels (AR = 2) with five different orientations of 45 deg V-shaped rib turbulators, J. Heat Transfer-Trans. ASME 125 (2) (2003) 232–242.

[615] L. Al-Hadhrami, J.C. Han, Effect of rotation on heat transfer in two-pass square channels with five different orientations of 45 deg angled rib turbulators, Int. J. Heat Mass Transfer 46 (4) (2003) 653–669.

[616] T.S. Griffith, L. Al-Hadhrami, J.C. Han, Heat transfer in rotating rectangular cooling channels (AR = 4) with dimples, J. Turbomach.-Trans. ASME 125 (3) (2003) 555–563.

[617] S.S. Hsieh, H.J. Chin, Turbulent flow in a rotating two pass ribbed rectangular channel, J. Turbomach.-Trans. ASME 125 (4) (2003) 609–622.

[618] T.M. Liou, M.Y. Chen, Y.M. Wang, Heat transfer, fluid flow, and pressure measurements inside a rotating two-pass duct with detached 90-deg ribs, J. Turbomach.-Trans. ASME 125 (3) (2003) 565–574.

[619] S.W. Chang, W.D. Morris, Heat transfer in a radially rotating square duct fitted with in-line transverse ribs, Int. J. Therm. Sci. 42 (3) (2003) 267–282.

[620] M.D. Polanka, D.A. Hoying, M. Meininger, C.D. MacArthur, Turbine tip and shroud heat transfer and loading—Part A: Parameter effects including Reynolds number, pressure ratio, and gas-to-metal temperature ratio, J. Turbomach.-Trans. ASME 125 (1) (2003) 97–106.

[621] T. Povey, K.S. Chana, T.V. Jones, Heat transfer measurements on an intermediate-pressure nozzle guide vane tested in a rotating annular turbine facility, and the modifying effects of a non-uniform inlet temperature profile, Proc. Inst. Mech. Eng. Part A-J. Power Energy 217 (A4) (2003) 421–431.

[622] M. Al-Qahtani, H.C. Chen, J.C. Han, A numerical study of flow and heat transfer in rotating rectangular channels (AR = 4) with 45 deg rib turbulators by Reynolds stress turbulence model, J. Heat Transfer-Trans. ASME 125 (1) (2003) 19–26.

[623] A. Murata, S. Mochizuki, Effect of cross-sectional aspect ratio on turbulent heat transfer in an orthogonally rotating rectangular duct with angled rib turbulators, Int. J. Heat Mass Transfer 46 (16) (2003) 3119–3133.

[624] R. Boutarfa, S. Harmand, Local convective heat exchanges and flow structure in a rotor–stator system, Int. J. Therm. Sci. 42 (12) (2003) 1129–1143.

[625] A.W. Hubner, M.J. Tummers, K. Hanjalic, T.H. van der Meer, Experiments on a rotating-pipe swirl burner, Exp. Therm. Fluid Sci. 27 (4) (2003) 481–489.

[626] I. Sumita, P. Olson, Experiments on highly supercritical thermal convection in a rapidly rotating hemispherical shell, J. Fluid Mech. 492 (2003) 271–287.

[627] S. Torii, W.J. Yang, Swirling effect on thermal-fluid transport phenomena in a strongly heated concentric annulus, J. Heat Transfer-Trans. ASME 125 (4) (2003) 604–611.

[628] S. Mahmud, R.A. Fraser, Analysis of entropy generation inside concentric cylindrical annuli with relative rotation, Int. J. Therm. Sci. 42 (5) (2003) 513–521.

[629] A.A. Svidzinsky, Radiation of neutron stars produced by superfluid core, Astrophys. J. 590 (1 Part 1) (2003) 386–410.

[630] M.S. Kotelnikova, S.V. Starchenko, Heat and mass transfer in the earth's liquid core decreasing in size, Izv.-Phys. Solid Earth 39 (11) (2003) 923–932.

[631] P. Arras, E.E. Flanagan, S. Morsink, A.K. Schenk, S.A. Teukolsky, I. Wasserman, Saturation of the r-mode instability, Astrophys. J. 591 (2 Part 1) (2003) 1129–1151.

[632] H. Niazmand, M. Renksizbulut, Transient three-dimensional heat transfer from rotating spheres with surface blowing, Chem. Eng. Sci. 58 (15) (2003) 3535–3554.

[633] Y.R. Li, D.F. Ruan, N. Imaishi, S.Y. Wu, L. Peng, D.L. Zeng, Global simulation of a silicon Czochralski furnace in an axial magnetic field, Int. J. Heat Mass Transfer 46 (15) (2003) 2887–2898.

[634] Y.R. Li, Y. Akiyama, N. Imaishi, T. Tsukada, Global analysis of a small Czochralski furnace with rotating crystal and crucible, J. Crystal Growth 255 (1–2) (2003) 81–92.

[635] R.U. Barz, M. Grassl, Experimental and numerical studies on temperature and flow fields in crystal growth from phosphoric acid solutions, J. Crystal Growth 249 (1–2) (2003) 345–353.

[636] V.E. Distanov, A.G. Kirdyashkin, Effect of accelerated crucible rotation on the radial impurity distribution in proustite single crystals, Inorg. Mater. 39 (7) (2003) 672–675.

[637] V.E. Distanov, A.G. Kirdyashkin, The influence of the intensity of melt stirring on the radial impurity distribution in proustite single crystals grown by the Stockbarger method using ACRT, J. Crystal Growth 250 (3–4) (2003) 324–330.

[638] C.W. Lan, I.F. Lee, B.C. Yeh, Three-dimensional analysis of flow and segregation in vertical Bridgman crystal growth under axial and transversal magnetic fields, J. Crystal Growth 254 (3–4) (2003) 503–515.

[639] J.K. Chen, J.E. Beraun, Modelling of ultrashort laser ablation of gold films in vacuum, J. Opt. A: Pure Appl. Opt. 5 (3) (2003) 168–173.

[640] A. Casavola, G. Colonna, A. De Giacomo, M. Capitelli, Laser ablation of titanium metallic targets: comparison between theory and experiment, J. Thermophys. Heat Transfer 17 (2) (2003) 225–231.

[641] I.H. Chowdhury, X.F. Xu, Heat transfer in femtosecond laser processing of metal, Numer. Heat Transfer Part A-Appl. 44 (3) (2003) 219–232.

[642] A.V. Gusarov, I. Smurov, Near-surface laser-vapour coupling in nanosecond pulsed laser ablation, J. Phys. D-Appl. Phys. 36 (23) (2003) 2962–2971.

[643] B.S. Yibas, S.Z. Shuja, M.S.J. Hashmi, A numerical solution for laser heating of titanium and nitrogen diffusion in solid, J. Mater. Process. Technol. 136 (1–3) (2003) 12–23.

[644] J.E. Mayhew, J.W. Baughn, A.R. Byerley, The effect of freestream turbulence on film cooling adiabatic effectiveness, Int. J. Heat Fluid Flow 24 (5) (2003) 669–679.

[645] C.H.N. Yuen, R.F. Martinez-Botas, Film cooling characteristics of a single round hole at various streamwise angles in a crossflow: Part I Effectiveness, Int. J. Heat Mass Transfer 46 (2) (2003) 221–235.

[646] C. Saumweber, A. Schulz, S. Wittig, Free-stream turbulence effects on film cooling with shaped holes, J. Turbomach.-Trans. ASME 125 (1) (2003) 65–73.

[647] C.H.N. Yuen, R.F. Martinez-Botas, Film cooling characteristics of a single round hole at various streamwise angles in a crossflow—Part II Heat transfer coefficients, Int. J. Heat Mass Transfer 46 (2) (2003) 237–249.

[648] J. Ahn, I.S. Jung, J.S. Lee, Film cooling from two rows of holes with opposite orientation angles: injectant behavior and adiabatic film cooling effectiveness, Int. J. Heat Fluid Flow 24 (1) (2003) 91–99.

[649] J. Dittmar, A. Schulz, S. Wittig, Assessment of various film-cooling configurations including shaped and compound angle holes based on large-scale experiments, J. Turbomach.-Trans. ASME 125 (1) (2003) 57–64.

[650] B. Petre, E. Dorignac, J.J. Vullierme, Study of the influence of the number of holes rows on the convective heat transfer in the case of full coverage film cooling, Int. J. Heat Mass Transfer 46 (18) (2003) 3477–3496.

[651] P. Martini, A. Schulz, C.F. Whitney, E. Lutam, Experimental and numerical investigation of trailing edge film cooling downstream of a slot with internal rib arrays, Proc. Inst. Mech. Eng. Part A-J. Power Energy 217 (A4) (2003) 393–401.

[652] H. Nasir, S. Acharya, S. Ekkad, Improved film cooling from cylindrical angled holes with triangular tabs: effect of tab orientations, Int. J. Heat Fluid Flow 24 (5) (2003) 657–668.

[653] H. Nasir, S.V. Ekkad, S. Acharya, Flat surface film cooling from cylindrical holes with discrete tabs, J. Thermophys. Heat Transfer 17 (3) (2003) 304–312.

[654] X. Yang, K.J. Badcock, B.E. Richards, A numerical study of hypersonic laminar film cooling, Aeronaut. J. 1074 (107) (2003) 479–486.

[655] M. Tyagi, S. Acharya, Large eddy simulation of film cooling flow from an inclined cylindrical jet, J. Turbomach.-Trans. ASME 125 (4) (2003) 734–742.

[656] D.R. Kirk, G.R. Guenette, S.P. Lukachko, I.A. Waitz, Gas turbine engine durability impacts of high fuel-air ratio combustors—Part II: Near-wall reaction effects on film-cooled heat transfer, J. Eng. Gas Turbines Power-Trans. ASME 125 (3) (2003) 751–759.

[657] B. Leger, P. Miron, J.M. Emidio, Geometric and aero-thermal influences on multiholed plate temperature: application on combustor wall, Int. J. Heat Mass Transfer 46 (7) (2003) 1215–1222.

[658] J.S. Kwak, J.C. Han, Heat transfer coefficients and film cooling effectiveness on the squealer tip of a gas turbine blade, J. Turbomach.-Trans. ASME 125 (4) (2003) 648–657.

[659] K. Ichimiya, Heat transfer characteristics of an annular turbulent impinging jet with a confined wall measured by thermosensitive liquid crystal, Heat Mass Transfer 39 (7) (2003) 545–551.

[660] K. Ichimiya, Y. Yamada, Three-dimensional heat transfer of a confined circular impinging jet with buoyancy effects, J. Heat Transfer-Trans. ASME 125 (2) (2003) 250–256.

[661] S.Z. Shuja, B.S. Yilbas, M. Rashid, Confined swirling jet impingement onto an adiabatic wall, Int. J. Heat Mass Transfer 46 (16) (2003) 2947–2955.

[662] M.Y. Wen, K.J. Jang, An impingement cooling on a flat surface by using circular jet with longitudinal swirling strips, Int. J. Heat Mass Transfer 46 (24) (2003) 4657–4667.

[663] L. Thielen, H.J.J. Jonker, K. Hanjalic, Symmetry breaking of flow and heat transfer in multiple impinging jets, Int. J. Heat Fluid Flow 24 (4) (2003) 444–453.

[664] E.A. Siba, M. Ganesa-Pillai, K.T. Harris, A. Haji-Sheikh, Heat transfer in a high turbulence air jet impinging over a flat circular disk, J. Heat Transfer-Trans. ASME 125 (2) (2003) 257–265.

[665] S. Roy, P. Patel, Study of heat transfer for a pair of rectangular jets impinging on an inclined surface, Int. J. Heat Mass Transfer 46 (3) (2003) 411–425.

[666] M. Kumari, G. Nath, Unsteady flow with heat and mass transfer due to impingement of slot jet on an inclined plate, Heat Mass Transfer 39 (8–9) (2003) 745–751.

[667] M. Can, Experimental optimization of air jets impinging on a continuously moving flat plate, Heat Mass Transfer 39 (5–6) (2003) 509–517.

[668] N. Gao, H. Sun, D. Ewing, Heat transfer to impinging round jets with triangular tabs, Int. J. Heat Mass Transfer 46 (14) (2003) 2557–2569.

[669] M. Rahimi, I. Owen, J. Mistry, Heat transfer between an underexpanded jet and a cylindrical surface, Int. J. Heat Mass Transfer 46 (17) (2003) 3135–3142.

[670] A.K. Chaniotis, D. Poulikakos, Y. Ventikos, Dual pulsating or steady slot jet cooling of a constant heat flux surface, J. Heat Transfer-Trans. ASME 125 (4) (2003) 575–586.

[671] D.S. Kercher, J.B. Lee, O. Brand, M.G. Allen, A. Glezer, Microjet cooling devices for thermal management of electronics, IEEE Trans. Compon. Packag. Technol. 26 (2) (2003) 359–366.

[672] C. Duty, R. Johnson, J. Gillespie, A. Fedorov, J. Lackey, Heat and mass-transfer modeling of an angled gas-jet LCVD system, Applied Physics a (Materials Science Processing) 77 (5) (2003) 697–705.

[673] M. Taslim, K. Bakhtari, H. Liu, Experimental and numerical investigation of impingement on a rib-roughened leading-edge wall, J. Turbomach.-Trans. ASME 125 (4) (2003) 682–691.

[674] V.F. Kosarev, S.V. Klinkov, A.P. Alkhimov, A.N. Papyrin, On some aspects of gas dynamics of the cold spray process, J. Therm. Spray Technol. 12 (2) (2003) 265–281.

[675] D.H. Rhee, J.H. Choi, H.H. Cho, Flow and heat (mass) transfer characteristics in an impingement/effusion cooling system with crossflow, J. Turbomach.-Trans. ASME 125 (1) (2003) 74–82.

[676] B. Merci, E. Dick, Heat transfer predictions with a cubic k–ε model for axisymmetric turbulent jets impinging onto a flat plate, Int. J. Heat Mass Transfer 46 (3) (2003) 469–480.

[677] B. Merci, J. Vierendeels, C. De Langhe, E. Dick, Numerical simulation of heat transfer of turbulent impinging jets with two-equation turbulence models, Int. J. Numer. Methods Heat Fluid Flow 13 (1) (2003) 110–132.

[678] D.V. Pence, P.A. Boeschoten, J.A. Liburdy, Simulation of compressible micro-scale jet impingement heat transfer, J. Heat Transfer-Trans. ASME 125 (3) (2003) 447–453.

[679] S. Marzouk, H. Mhiri, S. El Golli, G. Le Palec, P. Bournot, Numerical study of a heated pulsed axisymmetric jet in laminar mode, Numer. Heat Transfer Part A-Appl. 43 (4) (2003) 409–429.

[680] C.L. Leakeas, M.A.R. Sharif, Effects of thermal diffusion and substrate temperature on silicon deposition in an impinging-jet CVD reactor, Numer. Heat Transfer Part A-Appl. 44 (2) (2003) 127–147.

[681] F. Beaubert, S. Viazzo, Large eddy simulations of plane turbulent impinging jets at moderate Reynolds numbers, Int. J. Heat Fluid Flow 24 (4) (2003) 512–519.

[682] B.S. Yilbas, S.Z. Shuja, M.O. Budair, Jet impingement onto a hole with constant wall temperature, Numer. Heat Transfer Part A-Appl. 43 (8) (2003) 843–865.

[683] L.L. Dong, C.W. Leung, C.S. Cheung, Heat transfer characteristics of a pair of impinging rectangular flame jets, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1140–1146.

[684] L.L. Dong, C.W. Leung, C.S. Cheung, Combustion optimization of a slot flame jet impingement system, J. Inst. Energy 76 (508) (2003) 80–88.

[685] D.R. Buttsworth, T.V. Jones, Concentration probe measurements in a Mach 4 nonreacting hydrogen jet, J. Fluids Engineering-Trans. ASME 125 (4) (2003) 628–635.

[686] L.M. Su, S.W. Chang, S.F. Chiou, Impingement heat transfer of reciprocating jet array, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (3) (2003) 434–450.

[687] A. Brauer, M.J.M. English, N. Lorenz, N. Steinmetz, T. Perl, U. Braun, W. Weyland, Comparison of forced-air warming systems with lower body blankets using a copper manikin of the human body, Acta Anaesthesiol. Scand. 47 (1) (2003) 58–64.

[688] T. Perl, A. Brauer, A. Timmermann, F. Mielck, W. Weyland, U. Braun, Differences among forced-air warming systems with upper body blankets are small, A randomized trial for heat transfer in volunteers, Acta Anaesthesiol. Scand. 47 (9) (2003) 1159–1164.

[689] S. Chemonges-Nielsen, S. Sommerlad, L.J. Filippich, The effects of peripheral and central warming on body temperature during canine laparotomy, Aust. Vet. Practit. 33 (2) (2003) 50–56.

[690] M.W. Dae, D.W. Gao, P.C. Ursell, C.A. Stillson, D.I. Sessler, Safety and efficacy of endovascular cooling and rewarming for induction and reversal of hypothermia in human-sized pigs, Stroke 34 (3) (2003) 734–738.

[691] Y.S. Chen, J. Fan, W. Zhang, Clothing thermal insulation during sweating, Textile Res. J. 73 (2) (2003) 152–157.

[692] T.P. Gavin, Clothing and thermoregulation during exercise, Sports Medicine 33 (13) (2003) 941–947.

[693] N. Ghaddar, K. Ghali, B. Jones, Integrated human-clothing system model for estimating the effect of walking on clothing insulation, Int. J. Therm. Sci. 42 (6) (2003) 605–619.

[694] D.N. Sorensen, L.K. Voigt, Modelling flow and heat transfer around a seated human body by computational fluid dynamics, Build. Environ. 38 (6) (2003) 753–762.

[695] K.C. Lee, D.N. Jackson, D.L. Cordero, T. Nishiyasu, J.K. Peters, G.W. Mack, Change in spontaneous baroreflex control of pulse interval during heat stress in humans, J. Applied Physiology 95 (5) (2003) 1789–1798.

[696] G.P. Kenny, F.D. Reardon, W. Zaleski, M.L. Reardon, F. Haman, M.B. Ducharme, Muscle temperature transients before, during, and after exercise measured using an intramuscular multisensor probe, J. Applied Physiology 94 (6) (2003) 2350–2357.

[697] A.R.A. Khaled, K. Vafai, The role of porous media in modeling flow and heat transfer in biological tissues, Int. J. Heat Mass Transfer 46 (26) (2003) 4989–5003.

[698] Q.H. He, L. Zhu, S. Weinbaum, Effect of blood flow on thermal equilibration and venous rewarming, Annals of Biomedical Engineering 31 (6) (2003) 659–666.

[699] Z. Zhang, C. Kleinstreuer, Species heat and mass transfer in a human upper airway model, Int. J. Heat Mass Transfer 46 (25) (2003) 4755–4768.

[700] Z. Zhang, C. Kleinstreuer, Computational thermodynamics analysis of vaporizing fuel droplets in the human upper airways, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (4) (2003) 563–571.

[701] F. Seebacher, R.M. Elsey, P.L. Trosclair, Body temperature null distributions in reptiles with nonzero heat capacity: Seasonal thermoregulation in the American alligator (Alligator mississippiensis), Physiol. Biochem. Zool. 76 (3) (2003) 348–359.

[702] C.E. Franklin, F. Seebacher, The effect of heat transfer mode on heart rate responses and hysteresis during heating and cooling in the estuarine crocodile Crocodylus porosus, J. Experimental Biology 206 (7) (2003) 1143–1151.

[703] B. Mauck, K. Bilgmann, D.D. Jones, U. Eysel, G. Dehnhardt, Thermal windows on the trunk of hauled-out seals: hot spots for thermoregulatory evaporation, J. Experimental Biology 206 (10) (2003) 1727–1738.

[704] S.R.H. Davidson, D.F. James, Drilling in bone: Modeling heat generation and temperature distribution, J. Biomechanical Engineering 125 (3) (2003) 305–314.

[705] W.G. Sawyer, M.A. Hamilton, B.J. Fregly, S.A. Banks, Temperature modeling in a total knee joint replacement using patient-specific kinematics, Tribology Letters 15 (4) (2003) 343–351.

[706] V.V. Barun, A.P. Ivanov, Thermal action of a short light pulse on biological tissues, Int. J. Heat Mass Transfer 46 (17) (2003) 3243–3254.

[707] C.Y. Chen, L.X. Xu, A vascular model for heat transfer in an isolated pig kidney during water bath heating, J. Heat Transfer-Trans. ASME 125 (5) (2003) 936–943.

[708] K.A. Il'yasov, B. Eissner, J. Hennig, The effect of perfusion on the temperature distribution during thermotherapy: Study on perfused porcine kidneys, Applied Magnetic Resonance 24 (2) (2003) 215–224.

[709] A. Ito, F. Matsuoka, H. Honda, T. Kobayashi, Heat shock protein 70 gene therapy combined with hyperthermia using magnetic nanoparticles, Cancer Gene Therapy 10 (12) (2003) 918–925.

[710] H.S. Kou, T.C. Shih, W.L. Lin, Effect of the directional blood flow on thermal dose distribution during thermal therapy: an application of a Green's function based on the porous model, Phys. Med. Biol. 48 (11) (2003) 1577–1589.

[711] M.E. Kowalski, H.M. Jin, Model-order reduction of nonlinear models of electromagnetic phased-array hyperthermia, IEEE Transactions on Biomedical Engineering 50 (11) (2003) 1243–1254.

[712] M.E. Kowalski, J.M. Jin, A temperature-based feedback control system for electromagnetic phased-array hyperthermia: theory and simulation, Phys. Med. Biol. 48 (5) (2003) 633–651.

[713] N. Siauve, L. Nicolas, C. Vollaire, C. Marchal, 3D modelling of electromagnetic fields in local hyperthermia, Eur. Phys. J.-Applied Physics 21 (3) (2003) 243–250.

[714] G. Sreenivasa, J. Gellermann, B. Rau, J. Nadobny, P. Schlag, P. Deuflhard, R. Felix, P. Wust, Clinical use of the hyperthermia treatment planning system hyperplan to predict effectiveness and toxicity, Int. J. Radiation Oncology, Biology, Physics 55 (2) (2003) 407–419.

[715] B.K. Wang, X. Zhu, X.M. Cheng, S.Y. Lin, Inverse optimizing method of bio-temperature-field reconstruction in rf-capacitive hyperthermia, Chinese Physics Letters 20 (12) (2003) 2269–2272.

[716] J.C. Kumaradas, M.D. Sherar, Edge-element based finite element analysis of microwave hyperthermia treatments for superficial tumours on the chest wall, Int. J. Hyperthermia 19 (4) (2003) 414–430.

[717] D.A. Nelson, T.J. Walters, K.L. Ryan, K.B. Emerton, W.D. Hurt, J.M. Ziriax, L.R. Johnson, P.A. Mason, Inter-species extrapolation of skin heating resulting from millimeter wave irradiation: Modeling and experimental results, Health Physics 84 (5) (2003) 608–615.

[718] J.C. Kumaradas, M.D. Sherar, Optimization of a beam shaping bolus for superficial microwave hyperthermia waveguide applicators using a finite element method, Physics in Medicine and Biology 48 (1) (2003) 1–18.

[719] A.M. Brade, P. Szmitko, D. Ngo, F.F. Liu, H.J. Klamut, Heat-directed suicide gene therapy for breast cancer, Cancer Gene Therapy 10 (4) (2003) 294–301.

[720] A.M. Brade, P. Szmitko, D. Ngo, F.F. Liu, H.J. Klamut, Heat-directed tumor cell fusion, Human Gene Therapy 14 (5) (2003) 447–461.

[721] U. Pliquett, Joule heating during solid tissue electroporation, Med. Biol. Eng. Comput. 41 (2) (2003) 215–219.

[722] S.R.H. Davidson, M.D. Sherar, Theoretical modelling, experimental studies and clinical simulations of urethral cooling catheters for use during prostate thermal therapy, Phys. Med. Biol. 48 (6) (2003) 729–744.

[723] B.M. Pikkula, J.W. Tunnell, B. Anvari, Methodology for characterizing heat removal mechanism in human skin during cryogen spray cooling, Annals of Biomedical Engineering 31 (5) (2003) 493–504.

[724] G. Aguilar, G.X. Wang, J.S. Nelson, Effect of spurt duration on the heat transfer dynamics during cryogen spray cooling, Phys. Med. Biol. 48 (14) (2003) 2169–2181.

[725] L.O. Svaasand, L.L. Randeberg, G. Aguilar, B. Majaron, S. Kimel, E.J. Lavernia, J.S. Nelson, Cooling efficiency of cryogen spray during laser therapy of skin, Lasers in Surgery and Medicine 32 (2) (2003) 137–142.

[726] Y. Rabin, A general model for the propagation of uncertainty in measurements into heat transfer simulations and its application to cryosurgery, Cryobiology 46 (2) (2003) 109–120.

[727] Y. Rabin, T.F. Stahovich, Cryoheater as a means of cryosurgery control, Phys. Med. Biol. 48 (5) (2003) 619–632.

[728] K.L. Reed, T.D. Brown, M.G. Conzemius, Focal cryogen insults for inducing segmental osteonecrosis: computational and experimental assessments of thermal fields, J. Biomechanics 36 (9) (2003) 1317–1326.

[729] P. Gervais, I.M. de Maranon, C. Evrard, E. Ferret, S. Moundanga, Cell volume changes during rapid temperature shifts, J. Biotechnology 102 (3) (2003) 269–279.

[730] I. Szabo, M.R. Manning, A.A. Radzlevsky, M.A. Wetzel, T.J. Rogers, M.C. Ziskin, Low power millimeter wave irradiation exerts no harmful effect on human keratinocytes in vitro, Bioelectromagnetics 24 (3) (2003) 165–173.

[731] S.I. Alekseev, M.C. Ziskin, Local heating of human skin by millimeter waves: A kinetics study, Bioelectromagnetics 24 (8) (2003) 571–581.

[732] B. Mochnacki, E. Majchrzak, Sensitivity of the skin tissue on the activity of external heat sources, Comput. Model. Eng. Sci. 4 (3–4) (2003) 431–438.

[733] L. Mao, H.S. Udaykumar, J.O.M. Karlsson, Simulation of micro-scale interaction between ice and biological cells, Int. J. Heat Mass Transfer 46 (26) (2003) 5123–5136.

[734] J. Liu, Y.X. Zhou, Freezing curve-based monitoring to quickly evaluate the viability of biological materials subject to freezing or thermal injury, Anal. Bioanal. Chem. 377 (1) (2003) 173–181.

[735] Z.S. Deng, J. Liu, Non-Fourier heat conduction effect on prediction of temperature transients and thermal stress in skin cryopreservation, J. Therm. Stress. 26 (8) (2003) 779–798.

[736] C.C. Chen, Development of a heat transfer model for plant tissue culture vessels, Biosystems Engineering 85 (1) (2003) 67–77.

[737] M. Kleinhenz, B. Bujok, S. Fuchs, H. Tautz, Hot bees in empty broodnest cells: heating from within, J. Experimental Biology 206 (23) (2003) 4217–4231.

[738] C. Hartmann, A. Delgado, The influence of transport phenomena during high-pressure processing of packed food on the uniformity of enzyme inactivation, Biotechnol. Bioeng. 82 (6) (2003) 725–735.

[739] O. Wilhelm, L. Madler, S.E. Pratsinis, Electrospray evaporation and deposition, J. Aerosol Science 34 (7) (2003) 815–836.

[740] G. Miliauskas, Interaction of the transfer processes in semitransparent liquid droplets, Int. J. Heat Mass Transfer 46 (21) (2003) 4119–4138.

[741] G. Gogos, S. Soh, D.N. Pope, Effects of gravity and ambient pressure on liquid fuel droplet evaporation, Int. J. Heat Mass Transfer 46 (2003) 283–296.

[742] F. Dammel, H. Beer, Heat transfer from a continuous liquid to an evaporating drop: a numerical analysis, Int. J. Therm. Sci. 42 (7) (2003) 677–686.

[743] W. Cui, S. Chanda, S. McCahan, The effect of dissolving salts in water sprays used for quenching a hot surface: Part 1—Boiling of single droplets, J. Heat Transfer-Trans. ASME 125 (2) (2003) 326–332.

[744] M. Burger, R. Schmehl, K. Prommersberger, O. Schafer, R. Koch, S. Wittig, Droplet evaporation modeling by the distillation curve model: accounting for kerosene fuel and elevated pressures, Int. J. Heat Mass Transfer 46 (23) (2003) 4403–4412.

[745] J.C. Beck, A.P. Watkins, The droplet number moments approach to spray modelling: The development of heat and mass transfer sub-models, Int. J. Heat Fluid Flow 24 (2) (2003) 242–259.

[746] G.F. Yao, S.I. Abdel-Khalik, S.M. Ghiaasiaan, An investigation of simple evaporation models used in spray simulations, J. Heat Transfer-Trans. ASME 125 (1) (2003) 179–182.

[747] L.A. Dombrovsky, S.S. Sazhin, A parabolic temperature profile model for heating of droplets, J. Heat Transfer-Trans. ASME 125 (3) (2003) 535–537.

[748] L. Consolini, S.K. Aggarwal, S. Murad, A molecular dynamics simulation of droplet evaporation, Int. J. Heat Mass Transfer 46 (17) (2003) 3179–3188.

[749] G. Ben-Dor, T. Elperin, B. Krasovitov, Numerical analysis of the effects of temperature and concentration jumps on transient evaporation of moderately large (0.01 less than or similar to Kn less than or similar to 0.3) droplets in non-isothermal multicomponent gaseous mixtures, Heat Mass Transfer 39 (2) (2003) 157–166.

[750] N. Sozbir, Y.W. Chang, S.C. Yao, Heat transfer of impacting water mist on high temperature metal surfaces, J. Heat Transfer-Trans. ASME 125 (1) (2003) 70–74.

[751] L.M. Su, S.W. Chang, C.I. Yeh, Y.C. Hsu, Heat transfer of impinging air and liquid nitrogen mist jet onto superheated flat surface, Int. J. Heat Mass Transfer 46 (25) (2003) 4845–4862.

[752] K. Sefiane, L. Tadrist, M. Douglas, Experimental study of evaporating water–ethanol mixture sessile drop: influence of concentration, Int. J. Heat Mass Transfer 46 (23) (2003) 4527–4534.

[753] J. Richard, J.P. Garo, J.M. Souil, J.P. Vantelon, On the flame structure at the base of a pool fire interacting with a water mist, Exp. Therm. Fluid Sci. 27 (4) (2003) 439–448.

[754] N.C. Reis, R.F. Griffiths, M.D. Mantle, L.F. Gladden, Investigation of the evaporation of embedded liquid droplets from porous surfaces using magnetic resonance imaging, Int. J. Heat Mass Transfer 46 (7) (2003) 1279–1292.

[755] R. Raspet, W.V. Slaton, W.P. Arnott, H. Moosmuller, Evaporation-condensation effects on resonant photoacoustics of volatile aerosols, J. Atmospheric Oceanic Technol. 20 (5) (2003) 685–695.

[756] L.C. Lin, R. Ponnappan, Heat transfer characteristics of spray cooling in a closed loop, Int. J. Heat Mass Transfer 46 (20) (2003) 3737–3746.

[757] W. Jia, H.H. Qiu, Experimental investigation of droplet dynamics and heat transfer in spray cooling, Exp. Therm. Fluid Sci. 27 (7) (2003) 829–838.

[758] J.S. Wu, K.H. Hsu, P.M. Kuo, H.J. Sheen, Evaporation model of a single hydrocarbon fuel droplet due to ambient turbulence at intermediate Reynolds numbers, Int. J. Heat Mass Transfer 46 (24) (2003) 4741–4745.

[759] P. Ruffino, M. di Marzo, Temperature and volumetric fraction measurements in a hot gas laden with water droplets, J. Heat Transfer-Trans. ASME 125 (2) (2003) 356–364.

[760] L. Dombrovsky, S. Sazhin, Absorption of thermal radiation in a semi-transparent spherical droplet: a simplified model, Int. J. Heat Fluid Flow 24 (6) (2003) 919–927.

[761] W. Cui, S. Chandra, S. McCahan, The effect of dissolving salts in water sprays used for quenching a hot surface: Part 2—Spray cooling, J. Heat Transfer-Trans. ASME 125 (2) (2003) 333–338.

[762] V.N. Babak, T.B. Babak, L.P. Kholpanov, Simultaneous heat and momentum transfer in two-phase film systems at low pressure, Theoretical Foundations of Chemical Engineering 37 (4) (2003) 313–324.

[763] C. Boyadjiev, B. Boyadjiev, On the non-stationary evaporation kinetics. I. Mathematical model and experimental data, Int. J. Heat Mass Transfer 46 (9) (2003) 1679–1685.

[764] B. Boyadjiev, C. Boyadjiev, On the non-stationary evaporation kinetics. II. Stability, Int. J. Heat Mass Transfer 46 (9) (2003) 1687–1692.

[765] V.A.F. Costa, F.N. da Silva, On the rate of evaporation of water into a stream of dry air, humidified air and superheated steam, and the inversion temperature, Int. J. Heat Mass Transfer 46 (19) (2003) 3717–3726.

[766] C. Debbissi, J. Orfi, S. Ben Nasrallah, Evaporation of water by free or mixed convection into humid air and superheated steam, Int. J. Heat Mass Transfer 46 (24) (2003) 4703–4715.

[767] S. Jugjai, N. Polmart, Enhancement of evaporation and combustion of liquid fuels through porous media, Exp. Therm. Fluid Sci. 27 (8) (2003) 901–909.

[768] O. Khemis, M. Boumaza, M.A. Ali, M.X. Francois, Experimental analysis of heat transfers in a cryogenic tank without lateral insulation, Appl. Therm. Eng. 23 (16) (2003) 2107–2117.

[769] H.Y. Kim, B.H. Kang, Effects of hydrophilic surface treatment on evaporation heat transfer at the outside wall of horizontal tubes, Appl. Therm. Eng. 23 (4) (2003) 449–458.

[770] S. Yasui, T. Amakawa, Vaporization rate of cesium from molten slag in a plasma melting furnace for the treatment of simulated low-level radioactive wastes, Nucl. Technol. 141 (2) (2003) 167–176.

[771] V.V. Lukashov, On the determination of the surface temperature of an evaporating liquid, Theoretical Foundations of Chemical Engineering 37 (4) (2003) 325–329.

[772] C.E. Siewert, Heat transfer and evaporation/condensation problems based on the linearized Boltzmann equation, European Journal of Mechanics B-Fluids 22 (4) (2003) 391–408.

[773] K. Park, K.S. Lee, Flow and heat transfer characteristics of the evaporating extended meniscus in a micro-capillary channel, Int. J. Heat Mass Transfer 46 (24) (2003) 4587–4594.

[774] J.T. Zhang, B.X. Wang, Study on the interfacial evaporation of aqueous solution of SDS surfactant self-assembly monolayer, Int. J. Heat Mass Transfer 46 (26) (2003) 5059–5064.

[775] D. Bedeaux, E. Johannessen, A. Rosjorde, The nonequilibrium van der Waals square gradient model. (I). The model and its numerical solution, Physica A-Statist. Mech. Appl. 330 (3–4) (2003) 329–353.

[776] P.D. Blanken, W.R. Rouse, W.M. Schertzer, Enhancement of evaporation from a large northern lake by the entrainment of warm, dry air, J. Hydrometeorology 4 (4) (2003) 680–693.

[777] L. Bridge, R. Bradean, M.J. Ward, A.R. Wetton, The analysis of a two-phase zone with condensation in a porous medium, J. Engineering Mathematics 45 (3–4) (2003) 247–268.

[778] A. Belhamri, Characterization of the first falling rate period during drying of a porous material, Drying Technology 21 (7) (2003) 1235–1252.

[779] S.N. D'Yakonov, L.V. Kotlyarova, Y.I. Yalamov, The effect of the evaporation coefficient and temperature jumps on the thermophoresis of a particle in a binary gas mixture in view of thermodiffusion and Stefan effects, High Temperat. 41 (3) (2003) 384–398.

[780] I.M. Lee, H.J. Lee, J.Y. Cheon, L.N. Reddi, Evaporation theory for deformable soils, J. Geotech. Geoenviron. Eng. 129 (11) (2003) 1020–1027.

[781] Y. Tatemoto, Y. Mawatari, K. Sakurai, K. Noda, N. Komatsu, Drying characteristics of porous material in a fluidized bed of fluidizing particles with superheated steam, J. Chemical Engineering of Japan 36 (6) (2003) 655–662.

[782] L. Zheng, Y.X. Wang, P.C. Wayner, J.L. Plawsky, Microscale transport processes in the evaporator of a constrained vapor bubble, J. Thermophys. Heat Transfer 17 (2) (2003) 166–173.

[783] A.J. Szeri, B.D. Storey, A. Pearson, J.R. Blake, Heat and mass transfer during the violent collapse of nonspherical bubbles, Phys. Fluids 15 (9) (2003) 2576–2586.

[784] D. Albagli, A. Gany, High speed bubbly nozzle flow with heat, mass, and momentum interactions, Int. J. Heat Mass Transfer 46 (11) (2003) 1993–2003.

[785] P.G. Deng, Y.K. Lee, P. Cheng, The growth and collapse of a micro-bubble under pulse heating, Int. J. Heat Mass Transfer 46 (21) (2003) 4041–4050.

[786] A. Yasuda, H. Takahira, Numerical analysis of the dynamics of toroidal bubbles considering the heat transfer of internal gas, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (4) (2003) 600–609.

[787] V.M. Wasekar, R.N. Manglik, Short-time-transient surfactant dynamics and Marangoni convection around boiling nuclei, J. Heat Transfer-Trans. ASME 125 (5) (2003) 858–866.

[788] J. Kern, P. Stephan, Investigation of decisive mixture effects in nucleate boiling of binary mixtures using a theoretical model, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1116–1122.

[789] H. Wang, X.F. Peng, B.X. Wang, D.J. Lee, Bubble sweeping and jet flows during nucleate boiling of subcooled liquids, Int. J. Heat Mass Transfer 46 (5) (2003) 863–869.

[790] H. Wang, X.F. Peng, B.X. Wang, D.H. Lee, Bubble-sweeping mechanisms, Sci. China Ser. E-Technol. Sci. 46 (3) (2003) 225–233.

[791] D. Beysens, V. Nikolayev, Y. Garrabos, Vapour spreading and the boiling crisis, J. Physics-Condensed Matter 15 (1 Special Issue SI) (2003) S435–S442.

[792] T. Okawa, T. Tanaka, I. Kataoka, M. Mori, Temperature effect on single bubble rise characteristics in stagnant distilled water, Int. J. Heat Mass Transfer 46 (5) (2003) 903–913.

[793] B.B. Bayazit, D.K. Hollingsworth, L.C. Witte, Heat transfer enhancement caused by sliding bubbles, J. Heat Transfer-Trans. ASME 125 (3) (2003) 503–509.

[794] J. Kern, P. Stephan, Theoretical model for nucleate boiling heat and mass transfer of binary mixtures, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1106–1115.

[795] Q. Sun, R.C. Yang, H. Zhao, Predictive study of the incipient point of net vapor generation in low-flow subcooled boiling, Nucl. Eng. Design 225 (2–3) (2003) 249–256.

[796] V. Dupont, M. Miscevic, J.L. Joly, V. Platel, Boiling incipience of highly wetting liquids in horizontal confined space, Int. J. Heat Mass Transfer 46 (22) (2003) 4245–4256.

[797] T. Hibiki, M. Ishii, Active nucleation site density in boiling systems, Int. J. Heat Mass Transfer 46 (14) (2003) 2587–2601.

[798] H.S. Lee, H. Merte, G. Picker, J. Straub, Quasi-homogeneous boiling nucleation on a small spherical heater in microgravity, Int. J. Heat Mass Transfer 46 (26) (2003) 5087–5097.

[799] S. Heas, H. Robidou, M. Raynaud, M. Lallemand, Onset of transient nucleate boiling from a thick flat sample, Int. J. Heat Mass Transfer 46 (2003) 355–365.

[800] J.J. Wei, B. Yu, H.S. Wang, Heat transfer mechanisms in vapor mushroom region of saturated nucleate pool boiling, Int. J. Heat Fluid Flow 24 (2) (2003) 210–222.

[801] T.L. Chen, J.N. Chung, Heat-transfer effects of coalescence of bubbles from various site distributions, Proc. Roy. Soc. Lond. Ser. A-Math. Phys. Eng. Sci. 459 (2038) (2003) 2497–2527.

[802] H.J. Chung, H.C. No, Simultaneous visualization of dry spots and bubbles for pool boiling of R-113 on a horizontal heater, Int. J. Heat Mass Transfer 46 (12) (2003) 2239–2251.

[803] J. Yang, L.J. Guo, X.M. Zhang, A numerical simulation of pool boiling using CAS model, Int. J. Heat Mass Transfer 46 (25) (2003) 4789–4797.

[804] J. Margerit, P. Colinet, G. Lebon, C.S. Iorio, J.C. Legros, Interfacial nonequilibrium and Bénard–Marangoni instability of a liquid–vapor system—art. no. 041601, Phys. Rev. E 6804 (4 Part 1) (2003) 1601.

[805] H. Louahlia-Gualous, P.K. Panday, E.A. Artioukhine, Inverse determination of the local heat transfer coefficients for nucleate boiling on a horizontal cylinder, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1087–1095.

[806] L. Zhang, M. Shoji, Nucleation site interaction in pool boiling on the artificial surface, Int. J. Heat Mass Transfer 46 (3) (2003) 513–522.

[807] Y.H. Zhao, T. Tsuruta, C.Y. Ji, Experimental study of nucleate boiling heat transfer enhancement in confined space, Exp. Therm. Fluid Sci. 28 (1) (2003) 9–16.

[808] S.A. Zhukov, S.Y. Afanas'ev, S.B. Echmaev, Concerning the magnitude of the maximum heat flux and the mechanisms of superintensive bubble boiling, Int. J. Heat Mass Transfer 46 (18) (2003) 3411–3427.

[809] H.C. Lee, B.D. Oh, S.W. Bae, M.H. Kim, J.Y. Lee, I.S. Song, Partial nucleate boiling on the microscale heater maintaining constant wall temperature, J. Nucl. Sci. Technol. 40 (10) (2003) 768–774.

[810] H.C. Lee, B.D. Oh, S.W. Bae, M.H. Kim, Single bubble growth in saturated pool boiling on a constant wall temperature surface, Int. J. Multiphase Flow 29 (12) (2003) 1857–1874.

[811] A. Zimmermann, A.M. Holland, C.P. Garner, Indium tin oxide coated transparent surfaces for the study of nucleate boiling, Measurem. Sci. Technol. 14 (9) (2003) 1648–1654.

[812] M.Y. Wen, C.Y. Ho, Pool boiling heat transfer of deionized and degassed water in vertical/horizontal V-shaped geometries, Heat Mass Transfer 39 (8–9) (2003) 729–736.

[813] K.N. Rainey, S.M. You, S. Lee, Effect of pressure, subcooling, and dissolved gas on pool boiling heat transfer from microporous surfaces in FC-72, J. Heat Transfer-Trans. ASME 125 (1) (2003) 75–83.

[814] C. Ramaswamy, Y. Joshi, W. Nakayama, W.B. Johnson, Effects of varying geometrical parameters on boiling from microfabricated enhanced structures, J. Heat Transfer-Trans. ASME 125 (1) (2003) 103–109.

[815] S.S. Hsieh, G.Z. Huang, H.H. Tsai, Nucleate pool boiling characteristics from coated tube bundles in saturated R-134a. Int. J. Heat Mass Transfer 46 (7) (2003) 1223–1239.

[816] H. Honda, J. Wei, Advances in enhanced boiling heat transfer from electronic components, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (4) (2003) 479–490.

[817] R.J. Park, K.S. Ha, K.H. Kang, S.B. Kim, H.D. Kim, J.H. Jeong, Critical heat removal rate through a hemispherical narrow gap, Heat Mass Transfer 39 (3) (2003) 249–255.

[818] N. Acharya, M. Sen, E. Ramos, Periodicity and bifurcations in capillary tube boiling with a concentric heating wire, Int. J. Heat Mass Transfer 46 (8) (2003) 1425–1442.

[819] J. Birkholzer, Penetration of liquid fingers into superheated fractured rock—art. no. 1102, Water Resources Research 39 (4) (2003) 1102.

[820] C. Ramaswamy, Y. Joshi, W. Nakayama, W.B. Johnson, Semi-analytical model for boiling from enhanced structures, Int. J. Heat Mass Transfer 46 (22) (2003) 4257–4269.

[821] M. Arik, A. Bar-Cohen, Effusivity-based correlation of surface property effects in pool boiling CHF of dielectric liquids, Int. J. Heat Mass Transfer 46 (20) (2003) 3755–3764.

[822] I.M. Dergunov, P.V. Korolev, A.P. Kryukov, Y.Y. Selyaninova, Boiling of HeII in a porous structure in microgravity: a model representation, Low Temperature Physics 29 (6) (2003) 485–488.

[823] R.N. Krikkis, S.V. Sotirchos, P. Razelos, Multiplicity analysis of pin fins under multiboiling conditions, J. Enhanced Heat Transfer 10 (1) (2003) 95–117.

[824] J.J. Wei, H. Honda, Effects of fin geometry on boiling heat transfer from silicon chips with micro-pin-fins immersed in FC-72. Int. J. Heat Mass Transfer 46 (21) (2003) 4059–4070.

[825] O.C. Thomas, R.E. Cavicchi, M.J. Tarlov, Effect of surface Wettability on fast transient microboiling behavior, Langmuir 19 (15) (2003) 6168–6177.

[826] Y. Takata, S. Hidaka, M. Masuda, T. Ito, Pool boiling on a superhydrophilic surface, Int. J. Energy Res. 27 (2) (2003) 111–119.

[827] M.K. Usmani, M.A. Siddiqui, S.S. Alam, A.M. Jairajpuri, M. Kamil, Heat transfer studies during natural convection boiling in an internally heated annulus, Int. J. Heat Mass Transfer 46 (6) (2003) 1085–1095.

[828] G. Ribatski, J.M.S. Jabardo, Experimental study of nucleate boiling of halocarbon refrigerants on cylindrical surfaces, Int. J. Heat Mass Transfer 46 (23) (2003) 4439–4451.

[829] D. Jung, Y. Kim, Y. Ko, K.H. Song, Nucleate boiling heat transfer coefficients of pure halogenated refrigerants, Int. J. Refrig.-Rev. Int. Froid 26 (2) (2003) 240–248.

[830] D. Jung, K. Song, K. Ahn, J. Kim, Nucleate boiling heat transfer coefficients of mixtures containing HFC32, HFC125, and HFC134a, Int. J. Refrig.-Rev. Int. Froid 26 (7) (2003) 764–771.

[831] A.A. Voloshko, Heat-transfer intensity in boiling of binary mixtures of hydrocarbons, Theoretical Foundations of Chemical Engineering 37 (4) (2003) 330–338.

[832] H. Arima, M. Monde, Y. Mitsutake, Heat transfer in pool boiling of ammonia/water mixture, Heat Mass Transfer 39 (7) (2003) 535–543.

[833] M.A. Kedzierski, A semi-theoretical model for predicting refrigerant/lubricant mixture pool boiling heat transfer, Int. J. Refrig.-Rev. Int. Froid 26 (3) (2003) 337–348.

[834] S.M. You, J.H. Kim, K.H. Kim, Effect of nanoparticles on critical heat flux of water in pool boiling heat transfer, Applied Physics Letters 83 (16) (2003) 3374–3376.

[835] S.K. Das, N. Putra, W. Roetzel, Pool boiling characteristics of nano-fluids, Int. J. Heat Mass Transfer 46 (5) (2003) 851–862.

[836] S.K. Das, N. Putra, W. Roetzel, Pool boiling of nano-fluids on horizontal narrow tubes, Int. J. Multiphase Flow 29 (8) (2003) 1237–1247.

[837] J.O. Cosandey, A. Gunther, P.R. von Rohr, Transport of salts and micron-sized particles entrained from a boiling water pool, Exp. Therm. Fluid Sci. 27 (8) (2003) 877–889.

[838] T.L. Chen, J.N. Chung, An experimental study of miniature-scale pool boiling, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1074–1086.

[839] M.S. El-Genk, H. Bostanci, Saturation boiling of HFE-7100 from a copper surface, simulating a microelectronic chip, Int. J. Heat Mass Transfer 46 (10) (2003) 1841–1854.

[840] M.G. Kang, Effects of tube inclination on pool boiling heat transfer, Nuclear Engineering and Design 220 (1) (2003) 67–81.

[841] M. Najjari, S. Ben Nasrallah, Numerical study of boiling in an inclined porous layer, J. Porous Media 6 (1) (2003) 71–81.

[842] M.H. Shi, Y.B. Zhao, Z.L. Liu, Study on boiling heat transfer in liquid saturated particle bed and fluidized bed, Int. J. Heat Mass Transfer 46 (24) (2003) 4695–4702.

[843] J. Madadnia, H. Koosha, Electrohydrodynamic effects on characteristic of isolated bubbles in the nucleate pool boiling regime, Exp. Therm. Fluid Sci. 27 (2) (2003) 145–150.

[844] V.N. Skokov, V.P. Koverda, A.V. Reshetnikov, V.P. Skripov, N.A. Mazheiko, A.V. Vinogradov, 1/f noise and self-organized criticality in crisis regimes of heat and mass transfer, Int. J. Heat Mass Transfer 46 (10) (2003) 1879–1883.

[845] S.A. Zhukov, V.A. Rafeev, S.Y. Afanas'ev, S.B. Echmaev, B.L. Korsunskii, Singularities of realization of film boiling on wire heaters, Organic liquids, High Temperat. 41 (2) (2003) 243–251.

[846] S.A. Zhukov, S.Y. Afanas'ev, S.B. Echmaev, Special features in the realization of film boiling on wire heaters, Distilled water, High Temperat. 41 (4) (2003) 499–509.

[847] R.C. Jones, R.L. Judd, An investigation of dryout/rewetting in subcooled two-phase flow boiling, Int. J. Heat Mass Transfer 46 (17) (2003) 3143–3152.

[848] S.W. Peng, R. Revellin, D.C. Groeneveld, A.Z. Vasic, D. Shang, S.C. Cheng, Effects of flow obstacles on film boiling heat transfer, Nucl. Eng. Design 222 (1) (2003) 89–95.

[849] Z.H. Liu, Prediction of minimum heat flux for water jet boiling on a hot plate, J. Thermophys. Heat Transfer 17 (2) (2003) 159–165.

[850] V.S. Arpaci, H.S. Lee, Microscales of saturated pool film boiling, Int. J. Heat Mass Transfer 46 (20) (2003) 3809–3814.

[851] E. Leclerc, G.J. Berthoud, Modeling of melt droplet fragmentation following vapor film destabilization by a trigger pulse, Nucl. Technol. 144 (2) (2003) 158–174.

[852] L.A. Dombrovskii, Heat transfer by radiation through a vapor gap under conditions of film boiling of liquid, High Temperat. 41 (6) (2003) 819–824.

[853] D.C. Groeneveld, L.K.H. Leung, A.Z. Vasic, Y.J. Guo, S.C. Cheng, A look-up table for fully developed film-boiling heat transfer, Nucl. Eng. Design 225 (1) (2003) 83–97.

[854] F.J. Collado, Thermodynamics of flow boiling heat transfer, J. Non-Equilibrium Thermodynam. 28 (2) (2003) 167–177.

[855] A.E. Bergles, J.H. Lienhard, G.E. Kendall, P. Griffith, Boiling and evaporation in small diameter channels, Heat Transfer Eng. 24 (1) (2003) 18–40.

[856] D. Lhuillier, A mean-field description of two-phase flows with phase changes, Int. J. Multiphase Flow 29 (3) (2003) 511–525.

[857] R.D. Boyd, M. Strahan, P. Cofie, A. Ekhlassi, R. Martin, High heat flux removal using water subcooled flow boiling in a single-side heated circular channel, Int. J. Heat Mass Transfer 46 (21) (2003) 4105–4117.

[858] L. Zhao, L.J. Guo, B.F. Bai, Y.C. Hou, X.M. Zhang, Convective boiling heat transfer and two-phase flow characteristics inside a small horizontal helically coiled tubing once-through steam generator, Int. J. Heat Mass Transfer 46 (25) (2003) 4779–4788.

[859] H.Y. Wu, P. Cheng, Visualization and measurements of periodic boiling in silicon microchannels, Int. J. Heat Mass Transfer 46 (14) (2003) 2603–2614.

[860] J.R. Thome, J. El Hajal, Two-phase flow pattern map for evaporation in horizontal tubes: Latest version, Heat Transfer Eng. 24 (6) (2003) 3–10.

[861] B. Sumith, F. Kaminaga, K. Matsumura, Saturated flow boiling of water in a vertical small diameter tube, Exp. Therm. Fluid Sci. 27 (7) (2003) 789–801.

[862] Y. Rin, Y. Kim, M.S. Kim, Y. Choi, Boiling heat transfer and dryout phenomenon of CO2 in a horizontal smooth tube, Int. J. Heat Mass Transfer 46 (13) (2003) 2353–2361.

[863] W.L. Qu, I. Mudawar, Flow boiling heat transfer in two-phase micro-channel heat sinks—I. Experimental investigation and assessment of correlation methods, Int. J. Heat Mass Transfer 46 (15) (2003) 2755–2771.

[864] W.L. Qu, I. Mudawar, Flow boiling heat transfer in two-phase micro-channel heat sinks—II. Annular two-phase flow model, Int. J. Heat Mass Transfer 46 (15) (2003) 2773–2784.

[865] M. Lee, Y.Y. Wong, M. Wong, Y. Zohar, Size and shape effects on two-phase flow patterns in microchannel forced convection boiling, J. Micromechanics and Microengineering 13 (1) (2003) 155–164.

[866] M. Kureta, T. Hibiki, K. Mishima, H. Akimoto, Study on point of net vapor generation by neutron radiography in subcooled boiling flow along narrow rectangular channels with short heated length, Int. J. Heat Mass Transfer 46 (7) (2003) 1171–1181.

[867] T. Hibiki, Y. Mi, R. Situ, M. Ishii, Interfacial area transport of vertical upward bubbly two-phase flow in an annulus, Int. J. Heat Mass Transfer 46 (25) (2003) 4949–4962.

[868] T. Hibiki, R. Situ, Y. Mi, M. Ishii, Modeling of bubble-layer thickness for formulation of one-dimensional interfacial area transport equation in subcooled boiling two-phase flow (vol. 46, p. 1409, 2003), Int. J. Heat Mass Transfer 46 (18) (2003) 3549–3550.

[869] T. Hibiki, R. Situ, Y. Mi, M. Ishii, Modeling of bubble-layer thickness for formulation of one-dimensional interfacial area transport equation in subcooled boiling two-phase flow, Int. J. Heat Mass Transfer 46 (8) (2003) 1409–1423.

[870] T. Hibiki, R. Situ, Y. Mi, M. Ishii, Experimental study on interfacial area transport in vertical upward bubbly two-phase flow in an annulus, Int. J. Heat Mass Transfer 46 (3) (2003) 427–441.

[871] G. Hetsroni, M. Gurevich, A. Mosyak, E. Pogrebnyak, R. Rozeriblit, L.P. Yarin, Boiling in capillary tubes, Int. J. Multiphase Flow 29 (10) (2003) 1551–1563.

[872] B.S. Haynes, D.F. Fletcher, Subcooled flow boiling heat transfer in narrow passages, Int. J. Heat Mass Transfer 46 (19) (2003) 3673–3682.

[873] D. Brutin, F. Topin, L. Tadrist, Experimental study of unsteady convective boiling in heated minichannels, Int. J. Heat Mass Transfer 46 (16) (2003) 2957–2965.

[874] T.H. Yen, N. Kasagi, Y. Suzuki, Forced convective boiling heat transfer in microtubes at low mass and heat fluxes, Int. J. Multiphase Flow 29 (12) (2003) 1771–1792.

[875] R. Yun, Y.C. Kim, Critical quality prediction for saturated flow boiling of CO2 in horizontal small diameter tubes, Int. J. Heat Mass Transfer 46 (14) (2003) 2527–2535.

[876] W.L. Qu, I. Mudawar, Thermal design methodology for high-heat-flux single-phase and two-phase micro-channel heat sinks, IEEE Trans. Compon. Packag. Technol. 26 (3) (2003) 598–609.

[877] F. Francois, G. Berthoud, Extension of the compensated distortion method to the critical heat flux modelling in rectangular inclined channel, Int. J. Heat Mass Transfer 46 (14) (2003) 2673–2684.

[878] G. Hetsroni, D. Mewes, C. Enke, M. Gurevich, A. Mosyak, R. Rozenblit, Heat transfer to two-phase flow in inclined tubes, Int. J. Multiphase Flow 29 (2) (2003) 173–194.

[879] G.H. Su, J.L. Gou, S.Z. Qiu, X.Q. Yang, D.N. Jia, Theoretical calculation of annular upward flow in a narrow annuli with bilateral heating, Nucl. Eng. Design 225 (2–3) (2003) 219–247.

[880] J.R. Barbosa, G.F. Hewitt, S.M. Richardson, High-speed visualisation of nucleate boiling in vertical annular flow, Int. J. Heat Mass Transfer 46 (26) (2003) 5153–5160.

[881] C. Frepoli, J.H. Mahaffy, L.E. Hochreiter, A moving subgrid model for simulation of reflood heat transfer, Nucl. Eng. Design 224 (2) (2003) 131–148.

[882] T.A. Shedd, T.A. Newell, P.K. Lee, The effects of the number and angle of microgrooves on the liquid film in horizontal annular two-phase flow, Int. J. Heat Mass Transfer 46 (22) (2003) 4179–4189.

[883] S.S. Hsieh, K.J. Jang, H.H. Tsai, Evaporative characteristics of R-134a and R-600a in horizontal tubes with perforated strip-type inserts, Int. J. Heat Mass Transfer 46 (10) (2003) 1861–1872.

[884] A.P. Rupani, M. Molki, M.M. Ohadi, F.H.R. Franca, Enhanced flow boiling of R-134a in a minichannel plate evaporator, J. Enhanced Heat Transfer 10 (1) (2003) 1–7.

[885] M.U. Passos, V.F. Kuser, P. Haberschill, M. Lallemand, Convective boiling of R-407c inside horizontal microfin and plain tubes, Exp. Therm. Fluid Sci. 27 (6) (2003) 705–713.

[886] S.S. Hsieh, W.C. Lai, H.H. Tsai, LDV assisted bubble dynamic parameter measurements from two enhanced tubes boiling in saturated R-134a, Int. J. Heat Mass Transfer 46 (25) (2003) 4911–4923.

[887] G. Lorenzini, C. Biserni, A vapotron effect application for electronic equipment cooling, J. Electron. Packag. 125 (4) (2003) 475–479.

[888] Y.H. Lee, S.H. Chang, The effect of vibration on critical heat flux in a vertical round tube, J. Nucl. Sci. Technol. 40 (10) (2003) 734–743.

[889] W. Rivera, A. Xicale, O. Garcia-Valladares, Boiling heat transfer coefficients inside a vertical smooth tube for the water/lithium bromide mixture, Int. J. Energy Res. 27 (3) (2003) 265–275.

[890] S.G. Kandlikar, M. Bulut, An experimental investigation on flow boiling of ethylene-glycol/water mixtures, J. Heat Transfer-Trans. ASME 125 (2) (2003) 317–325.

[891] E.C. Hong, J.Y. Shin, M.S. Kim, K. Min, S.T. Ro, Prediction of forced convective boiling heat transfer coefficient of pure refrigerants and binary refrigerant mixtures inside a horizontal tube, KSME Int. J. 17 (6) (2003) 935–944.

[892] J.R. Barbosa, G.F. Hewitt, S.M. Richardson, A note on the influence of droplet interchange on evaporation and condensation of multicomponent mixtures in annular flow, Int. J. Heat Mass Transfer 46 (13) (2003) 2505–2509.

[893] Y. Feng, J. Seyed-Yagoobi, Mechanism of annular two-phase flow heat transfer enhancement and pressure drop penalty in the presence of a radial electric field—turbulence analysis, J. Heat Transfer-Trans. ASME 125 (3) (2003) 478–486.

[894] J.S. Cotton, D. Brocilo, J.S. Chang, M. Shoukri, T. Smith-Pollard, Numerical simulation of electric field distributions in electrohydrodynamic two-phase flow regimes, IEEE Trans. Dielectrics Electrical Insulat. 10 (1) (2003) 37–51.

[895] W. Chen, T. Hasegawa, A. Tsutsumi, K. Otawara, Y. Shigaki, Generalized dynamic modeling of local heat transfer in bubble columns, Chem. Eng. J. 96 (1–3) (2003) 37–44.

[896] W. Timm, K. Weinzierl, A. Leipertz, Heat transfer in subcooled jet impingement boiling at high wall temperatures, Int. J. Heat Mass Transfer 46 (8) (2003) 1385–1393.

[897] Y. Mitsutake, M. Monde, Ultra high critical heat flux during forced flow boiling heat transfer with an impinging jet, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1038–1045.

[898] H. Robidou, H. Auracher, P. Gardin, M. Lebouche, L. Bogdanic, Local heat transfer from a hot plate to a water jet, Heat Mass Transfer 39 (10) (2003) 861–867.
[899] V. Dupont, J.L. Joly, M. Miscevic, V. Plate, Capillary pumped loop startup: effects of the wick fit on boiling incipience, J. Thermophys. Heat Transfer 17 (2) (2003) 138–144.
[900] H. Yi, Z.H. Liu, J. Wang, Heat transfer characteristics of the evaporator section using small helical coiled pipes in a looped heat pipe, Appl. Therm. Eng. 23 (1) (2003) 89–99.
[901] Y.X. Wang, G.P. Peterson, Capillary evaporation in microchanneled polymer films, J. Thermophys. Heat Transfer 17 (3) (2003) 354–359.
[902] D.Y. Hsieh, On damping coefficient due to phase transformation, Acta Mech. Sinica/Lixue Xuebao 19 (3) (2003) 204–207.
[903] F. Mendez, C. Trevino, Analysis of a forced laminar film condensation including finite longitudinal heat conduction effects, Heat Mass Transfer 39 (5–6) (2003) 489–498.
[904] H. Kalman, Condensation of bubbles in miscible liquids, Int. J. Heat Mass Transfer 46 (18) (2003) 3451–3463.
[905] M. Goldbrunner, J. Karl, D. Hein, Concentration and temperature measurements by means of Raman spectroscopy in case of condensation with non-condensable gas, Kerntechnik 68 (3) (2003) 106–113.
[906] H.S. Park, H.C. No, Y.S. Bang, Analysis of experiments for in-tube steam condensation in the presence of noncondensable gases at a low pressure using the RELAP5/MOD3.2 code modified with a non-iterative condensation model, Nucl. Eng. Design 225 (2–3) (2003) 173–190.
[907] X.Z. Du, T.S. Zhao, Analysis of film condensation heat transfer inside a vertical micro tube with consideration of the meniscus draining effect, Int. J. Heat Mass Transfer 46 (24) (2003) 4669–4679.
[908] X.Z. Du, B.X. Wang, Study on transport phenomena for flow film condensation in vertical mini-tube with interfacial waves, Int. J. Heat Mass Transfer 46 (11) (2003) 2095–2101.
[909] W.B. Chen, R.B.H. Tan, Theoretical analysis of two-phase bubble formation in an immiscible liquid, AIChE J. 49 (8) (2003) 1964–1971.
[910] P.K. Panday, Two-dimensional turbulent film condensation of vapours flowing inside a vertical tube and between parallel plates: a numerical approach, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 492–503.
[911] M. Asbik, H. Boushaba, R. Chaynane, B. Zeghmati, A. Khmou, Prediction of onset of boundary layer transition in film condensation on a horizontal elliptical cylinder, Numer. Heat Transfer Part A-Appl. 43 (1) (2003) 83–109.
[912] R. Wurfel, T. Kreutzer, W. Fratzscher, Turbulence transfer processes in adiabatic and condensing film flow in an inclined tube, Chem. Eng. Technol. 26 (4) (2003) 439–448.
[913] Y. Utaka, T. Nishikawa, Measurement of condensate film thickness for solutal marangoni condensation applying laser extinction method, J. Enhanced Heat Transfer 10 (2) (2003) 119–129.
[914] J.R. Thome, J. El Hajal, A. Cavallini, Condensation in horizontal tubes, Part 2: new heat transfer model based on flow regimes, Int. J. Heat Mass Transfer 46 (18) (2003) 3365–3387.
[915] K. Stephan, Multicomponent phase equilibria of thin liquid films and their vapour, Chem. Eng. Sci. 58 (16) (2003) 3611–3620.
[916] J.R. Baird, D.F. Fletcher, B.S. Haynes, Local condensation heat transfer rates in fine passages, Int. J. Heat Mass Transfer 46 (23) (2003) 4453–4466.
[917] C.K. Chen, H.P. Hu, Turbulent film condensation on a half oval body, Int. J. Heat Mass Transfer 46 (22) (2003) 4271–4277.
[918] C.K. Chen, H.P. Hu, Turbulent film condensation on a horizontal elliptical tube, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1194–1197.
[919] M.J. Wilson, T.A. Newell, J.C. Chato, C.A.I. Ferreira, Refrigerant charge, pressure drop, and condensation heat transfer in flattened tubes, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 442–451.
[920] C. Aprea, A. Greco, G.P. Vanoli, Condensation heat transfer coefficients for R22 and R407C in gravity driven flow regime within a smooth horizontal tube, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 393–401.
[921] R. Bassi, P.K. Bansal, In-tube condensation of mixture of R134a and ester oil: empirical correlations, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 402–409.
[922] E. Begg, B. Holley, A. Faghri, Condensation heat transfer and pressure drop measurements in miniature horizontal tubes with low mass flux rates, J. Enhanced Heat Transfer 10 (3) (2003) 335–354.
[923] M. Goto, N. Inoue, R. Yonemoto, Condensation heat transfer of R410A inside internally grooved horizontal tubes, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 410–416.
[924] H. Honda, N. Takata, H. Takamatsu, J.S. Kim, K. Usami, Effect of fin geometry on condensation of R407C in a staggered bundle of horizontal finned tubes, J. Heat Transfer-Trans. ASME 125 (4) (2003) 653–660.
[925] N.H. Kim, J.P. Cho, J.O. Kim, B. Youn, Condensation heat transfer of R-22 and R-410A in flat aluminum multi-channel tubes with or without micro-fins, Int. J. Refrig.-Rev. Int. Froid 26 (7) (2003) 830–839.
[926] S. Koyama, K. Kuwahara, K. Nakashita, K. Yamamoto, An experimental study on condensation of refrigerant R134a in a multi-port extruded tube, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 425–432.
[927] T. Xie, S.J. Eckels, An investigation of condensation heat transfer performance of HFC-134a on single enhanced tubes (RP-984), Hvac&R Res. 9 (1) (2003) 3–18.
[928] A. Briggs, H.S. Wang, T. Murase, J.W. Rose, Heat transfer measurements for condensation of steam on a horizontal wire-wrapped tube, J. Enhanced Heat Transfer 10 (4) (2003) 355–362.
[929] T.A. Shedd, T.A. Newell, Visualization of two-phase flow through microgrooved tubes for understanding enhanced heat transfer, Int. J. Heat Mass Transfer 46 (22) (2003) 4169–4177.
[930] C.A.I. Ferreira, T.A. Newell, J.C. Chato, X. Nan, R404A condensing under forced flow conditions inside smooth, microfin and cross-hatched horizontal tubes, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 433–441.
[931] A. Miyara, Y. Otsubo, S. Ohtsuka, Y. Mizuta, Effects of fin shape on condensation in herringbone microfin tubes, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 417–424.
[932] H.S. Wang, H. Honda, Condensation of refrigerants in horizontal microfin tubes: comparison of prediction methods for heat transfer, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 452–460.
[933] D. Butrymowicz, M. Trela, J. Karwacki, Enhancement of condensation heat transfer by means of passive and active condensate drainage techniques, Int. J. Refrig.-Rev. Int. Froid 26 (4) (2003) 473–484.
[934] K. Brand, J. Seyed-Yagoobi, Pumping of refrigerant liquid film with electrohydrodynamic induction pumping mechanism—Theoretical and experimental study, Hvac&R Res. 9 (4) (2003) 415–433.
[935] K. Brand, J. Seyed-Yagoobi, Experimental study of electrohydrodynamic induction pumping of a dielectric micro liquid film in external horizontal condensation process, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1096–1105.
[936] D. Jung, K. Song, K. Kim, K. An, Condensation heat transfer coefficients of halogenated binary refrigerant mixtures on a smooth tube, Int. J. Refrig.-Rev. Int. Froid 26 (7) (2003) 795–799.
[937] M. Belghazi, A. Bontemps, C. Marvillet, Experimental study and modelling of heat transfer during condensation of pure fluid and binary mixture on a bundle of horizontal finned tubes, Int. J. Refrig.-Rev. Int. Froid 26 (2) (2003) 214–223.
[938] D.X. Jin, J.T. Kwon, M.H. Kim, Prediction of in-tube condensation heat transfer characteristics of binary refrigerant mixtures, Int. J. Refrig.-Rev. Int. Froid 26 (5) (2003) 593–600.
[939] S.M. Sami, J.D. Comeau, Study of viscosity and thermal conductivity effects on condensation characteristics of some new alternative refrigerant mixtures, Int. J. Energy Res. 27 (1) (2003) 63–77.

[940] K.A.R. Ismail, J.R. Henriquez, T.M. da Silva, A parametric study on ice formation inside a spherical capsule, Int. J. Therm. Sci. 42 (9) (2003) 881–887.

[941] S. Petrescu, L. Horoba, C. Lisa, Local heat transfer coefficient at spherical particle melting, Revue Roumaine de Chimie 48 (3) (2003) 237–242.

[942] P. Verboven, N. Scheerlinck, B.M. Nicolai, Surface heat transfer coefficients to stationary spherical particles in an experimental unit for hydrofluidisation freezing of individual foods, Int. J. Refrig.-Rev. Int. Froid 26 (3) (2003) 328–336.

[943] S. Lin, Z. Jiang, An improved quasi-steady analysis for solving freezing problems in a plate, a cylinder and a sphere, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1123–1128.

[944] K.A.R. Ismail, M.D. da Silva, Numerical solution of the phase change problem around a horizontal cylinder in the presence of natural convection in the melt region, Int. J. Heat Mass Transfer 46 (10) (2003) 1791–1799.

[945] T. Basak, Analysis of resonances during microwave thawing of slabs, Int. J. Heat Mass Transfer 46 (22) (2003) 4279–4301.

[946] R.V. Seeniraj, N.P. Kannan, Magnetic field effects upon heat transfer for laminar flow of electrically conducting liquid over a melting slab, Int. J. Heat Mass Transfer 46 (9) (2003) 1599–1605.

[947] M. Sugawara, T.F. Irvine, M. Tago, Heat and mass transfer characteristics of a temperature and concentration combined convection due to a vertical ice plate melting, J. Heat Transfer-Trans. ASME 125 (1) (2003) 39–47.

[948] J.F. Nastaj, A parabolic cylindrical Stefan problem in vacuum freeze drying of random solids, Int. Commun. Heat Mass Transfer 30 (1) (2003) 93–104.

[949] S. Savovic, J. Caldwell, Finite difference solution of one-dimensional Stefan problem with periodic boundary conditions, Int. J. Heat Mass Transfer 46 (15) (2003) 2911–2916.

[950] A.I. Fedorchenko, A.A. Chernov, Exact solution of the problem of gas segregation in the process of crystallization, Int. J. Heat Mass Transfer 46 (5) (2003) 915–919.

[951] J.D. Chung, H.S. Yoo, Similarity solution for peritectic solidification with shrinkage-induced flow, J. Thermophys. Heat Transfer 17 (4) (2003) 481–487.

[952] M. Elhadrouz, T. Ben Zineb, E. Patoor, Heat conduction during phase transformation in shape memory alloy, Journal de Physique IV 112 (Part 1) (2003) 183–186.

[953] A. Amarante, J.L. Lanoiselle, A. Ramirez, Direct measurement of heat transfer rates and coefficients in freezing processes by the use of heat flux sensors, Chem. Eng. Res. Design 81 (A9) (2003) 1105–1112.

[954] C.H. Cheng, K.H. Wu, Observations of early-stage frost formation on a cold plate in atmospheric air flow, J. Heat Transfer-Trans. ASME 125 (1) (2003) 95–102.

[955] A.R. Karev, M. Farzaneh, E.P. Lozowski, Character and stability of a wind-driven supercooled water film on an icing surface—I. Laminar heat transfer, Int. J. Therm. Sci. 42 (5) (2003) 481–498.

[956] A.R. Karev, M. Farzaneh, E.P. Lozowski, Character and stability of a wind-driven supercooled water film on an icing surface—II. Transition and turbulent heat transfer, Int. J. Therm. Sci. 42 (5) (2003) 499–511.

[957] G. Sui, M.C. Leu, Thermal analysis of ice walls built by rapid freeze prototyping, J. Manuf. Sci. Eng., Trans. ASME 125 (4) (2003) 824–834.

[958] G.H. Sui, M.C. Leu, Investigation of layer thickness and surface roughness in rapid freeze prototyping, J. Manuf. Sci. Eng., Trans. ASME 125 (3) (2003) 556–563.

[959] J.E. Weber, Heat, salt and mass transfer at a cold ice wall exposed to seawater near its freezing point, Geophys. Astrophys. Fluid Dynamics 97 (3) (2003) 213–224.

[960] K.A.R. Ismail, M.M. Radwan, Modeling of ice crystal growth in laminar falling films for the production of pumpable ice slurries, Energy Convers. Manage. 44 (2003) 65–84.

[961] P.J. Mago, S.A. Sherif, Heat and mass transfer on a cylinder surface in cross flow under supersaturated frosting conditions, Int. J. Refrig.-Rev. Int. Froid 26 (8) (2003) 889–899.

[962] E. Baake, B. Nacke, F. Bernier, M. Vogt, A. Muhlbauer, Experimental and numerical investigations of the temperature field and melt flow in the induction furnace with cold crucible, Compel-the International Journal for Computation and Mathematics in Electrical and Electronic Eng. 22 (1) (2003) 88–97.

[963] E. Baake, B. Nacke, A. Umbrashko, A. Jakovics, Turbulent flow dynamics, heat transfer and mass exchange in the melt of induction furnaces, Compel-the International Journal for Computation and Mathematics in Electrical and Electronic Eng. 22 (1) (2003) 39–47.

[964] H.B. Chen, U. Sundararaj, K. Nandakumar, Experimental and simulation studies of heat transfer in polymer melts, AIChE J. 49 (6) (2003) 1372–1382.

[965] H. Gan, J.J. Feng, H.H. Hu, Simulation of the sedimentation of melting solid particles, Int. J. Multiphase Flow 29 (5) (2003) 751–769.

[966] M.E. Glicksman, A. Lupulescu, M.B. Koss, Melting in microgravity, J. Thermophys. Heat Transfer 17 (1) (2003) 69–76.

[967] L. Gorbunov, A. Pedchenko, A. Feodorov, E. Tomzig, J. Virbulis, W.V. Ammon, Physical modelling of the melt flow during large-diameter silicon single crystal growth, J. Crystal Growth 257 (1–2) (2003) 7–18.

[968] D.S. Ivanov, L.V. Zhigilei, Combined atomistic-continuum modeling of short-pulse laser melting and disintegration of metal films—art. no. 064114, Phys. Rev. B 6806 (6) (2003) 4114.

[969] J.F. Kuniholm, N. Ma, Natural convection in a liquid-encapsulated molten semiconductor with a steady magnetic field, Int. J. Heat Fluid Flow 24 (1) (2003) 130–136.

[970] M. Lappa, S. Yusushiro, N. Imaishi, 3D numerical simulation of on ground Marangoni flow instabilities in liquid bridges of low Prandtl number fluid, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 309–340.

[971] H.M. Laun, Pressure dependent viscosity and dissipative heating in capillary rheometry of polymer melts, Rheol. Acta 42 (4) (2003) 295–308.

[972] H. Li, M.W. Li, W.R. Hu, D.L. Zeng, Suppression of Marangoni convection of silicon melt by a non-contaminating method, Int. J. Heat Mass Transfer 46 (25) (2003) 4969–4973.

[973] K. Li, W.R. Hu, Influence of local magnetic fields on P-doped Si floating zone melting crystal growth in microgravity, Cryst. Growth Design 3 (1) (2003) 73–78.

[974] K. Li, B.Q. Li, H.C. de Groh, Three-dimensional gravity-jitter induced melt flow and solidification in magnetic fields, J. Thermophys. Heat Transfer 17 (4) (2003) 498–508.

[975] T.P. Lyubimova, R.V. Scuridin, A. Croll, P. Dold, Influence of high frequency vibrations on fluid flow and heat transfer in a floating zone, Cryst. Res. Technol. 38 (7–8) (2003) 635–653.

[976] Y.K. Oh, S.H. Park, Heat transfer across liquid–solid interface in the absence and presence of acoustic streaming, J. Chem. Eng. Jpn. 36 (8) (2003) 985–990.

[977] T. Kimura, K. Arafune, K. Balakrishnan, T. Ozawa, Y. Okano, N. Murakami, H. Adachi, Y. Hayakawa, M. Kumagawa, Numerical analysis of the dissolution process of GaSb into InSb melt under different gravity conditions, J. Crystal Growth 247 (3–4) (2003) 291–300.

[978] C.S. Ray, D.E. Day, Progress and perspective of processing glass forming melts in low gravity, J. Thermophys. Heat Transfer 17 (2) (2003) 174–181.

[979] Y.C. Shih, F.B. Cheung, J.H. Koo, B.C. Yang, Numerical study of transient thermal ablation of high-temperature insulation materials, J. Thermophys. Heat Transfer 17 (1) (2003) 53–61.

[980] A. Tavarez, J.E. Gonzalez, Modeling the thermal behavior of solder paste inside reflow ovens, J. Electron. Packag. 125 (3) (2003) 335–346.

[981] M. Thiemann, A.R. Buchner, Heat flux density and heat transfer coefficient between steel melt and metallic substrates, Steel Res. Int. 74 (11–12) (2003) 732–738.

[982] C.C. Tseng, R. Viskanta, Effect of subcooling on convective melting of a particle, Int. Commun. Heat Mass Transfer 30 (1) (2003) 13–25.

[983] A. Vargas-Zamora, R.D. Morales, M. Diaz-Cruz, J. Palafox-Ramos, L.G. Demedices, Heat and mass transfer of a convective-stratified flow in a trough type tundish, Int. J. Heat Mass Transfer 46 (16) (2003) 3029–3039.

[984] G.X. Wang, C.C. Yao, B.T.F. Chung, Thermal analysis on planar interface stability in solidification of semitransparent materials, J. Thermophys. Heat Transfer 17 (2) (2003) 193–198.

[985] D.M. Wei, H.B. Luo, Finite element solutions of heat transfer in molten polymer flow in tubes with viscous dissipation, Int. J. Heat Mass Transfer 46 (16) (2003) 3097–3108.

[986] J.L. Xia, I. Ahokainen, Homogenization of temperature field in a steelmaking ladle with gas injection, Scand. J. Metall. 32 (4) (2003) 211–217.

[987] H.B. Yin, J.N. Koster, Chemical stratification and solidification in a differentially heated melt, J. Alloys Comp. 352 (1–2) (2003) 197–209.

[988] Y.X. Zhang, Z.J. Xu, Kinetics of convective crystal dissolution and melting, with applications to methane hydrate dissolution and dissociation in seawater, Earth Planet. Sci. Lett. 213 (1–2) (2003) 133–148.

[989] G.Y. Zheng, I.S. Wichman, A. Bénard, Energy balance analysis of ignition over a melting polymer subjected to a high radiation heat flux in a channel cross flow, Fire Safety J. 38 (3) (2003) 229–256.

[990] S. Kim, S. Anghaie, G. Chen, Numerical prediction of multicellular melt flow during natural convection-dominated melting, J. Thermophys. Heat Transfer 17 (1) (2003) 62–68.

[991] S.S. Sripada, I.M. Cohen, P.S. Ayyaswamy, Melting of a wire anode followed by solidification: a three-phase moving interface problem, J. Heat Transfer-Trans. ASME 125 (4) (2003) 661–668.

[992] Y.L. Hao, Y.X. Tao, Non-thermal equilibrium melting of granular packed bed in horizontal forced convection. Part I: experiment, Int. J. Heat Mass Transfer 46 (26) (2003) 5017–5030.

[993] Y.L. Hao, Y.X. Tao, Non-thermal equilibrium melting of granular packed bed in horizontal forced convection. Part II: numerical simulation, Int. J. Heat Mass Transfer 46 (26) (2003) 5031–5044.

[994] N.K. Tolochko, M.K. Arshinov, A.V. Gusarov, V.I. Titov, T. Laoui, L. Froyen, Mechanisms of selective laser sintering and heat transfer in Ti powder, Rapid Prototyp. J. 9 (5) (2003) 314–326.

[995] Z.Y. Wei, K.M. Lee, S.W. Tchikanda, Z. Zhou, S.P. Hong, Effects of radiative transfer modeling on transient temperature distribution in semitransparent glass rod, J. Heat Transfer-Trans. ASME 125 (4) (2003) 635–643.

[996] H. Dong, H. Gao, L. Wu, Numerical simulation of heat transfer and fluid flow in a double-sided gas-tungsten arc welding process, Proc. Inst. Mech. Eng. Part B-Journal of Eng. Manufacture 217 (1) (2003) 87–97.

[997] X. He, P.W. Fuerschbach, T. DebRoy, Heat transfer and fluid flow during laser spot welding of 304 stainless steel, J. Physics D-Appl. Phys. 36 (12) (2003) 1388–1398.

[998] R. Trivedi, S.A. David, M.A. Eshelman, J.M. Vitek, S.S. Babu, T. Hong, T. DebRoy, In situ observations of weld pool solidification using transparent metal-analog systems, J. Appl. Phys. 93 (8) (2003) 4885–4895.

[999] F. Wang, W.K. Hou, S.J. Hu, E. Kannatey-Asibu, W.W. Schultz, P.C. Wang, Modelling and analysis of metal transfer in gas metal arc welding, J. Physics D-Appl. Phys. 36 (9) (2003) 1143–1152.

[1000] P.S. Wei, Y.H. Chen, J.S. Ku, C.Y. Ho, Active solute effects on surface ripples in electron-beam welding solidification, Metall. Mater. Trans. B-Process Metall. Mater. Process. Sci. 34 (4) (2003) 421–432.

[1001] W. Zhang, G.G. Roy, J.W. Elmer, T. DebRoy, Modeling of heat transfer and fluid flow during gas tungsten arc spot welding of low carbon steel, J. Appl. Phys. 93 (5) (2003) 3022–3033.

[1002] N. Chakraborty, S. Chakraborty, P. Dutta, Modelling of turbulent transport in arc welding pools, Int. J. Numer. Methods Heat Fluid Flow 13 (1) (2003) 7–30.

[1003] N. Hannoun, V. Alexiades, T.Z. Mai, Resolving the controversy over tin and gallium melting in a rectangular cavity heated from the side, Numer. Heat Transfer B-Fundament. 44 (3) (2003) 253–276.

[1004] G.V. Kuznetsov, A.V. Krainov, Conjugate heat and mass transfer under conditions of motion of a viscous incompressible liquid in an open rectangular cavity and wall melting, High Temperat. 41 (2) (2003) 252–256.

[1005] S.D. Lee, K.Y. Suh, Natural convection heat transfer in two-dimensional semicircular slice pool, J. Nucl. Sci. Technol. 40 (10) (2003) 775–782.

[1006] S. Chakraborty, P. Dutta, Analytical solutions for heat transfer during cyclic melting and freezing of a phase change material used in electronic or electrical packaging, J. Electron. Packag. 125 (1) (2003) 126–133.

[1007] C.H. Cheng, M.H. Chang, Shape identification for water–ice interface within the cylindrical capsule in cold storage system by inverse heat transfer method, Int. J. Refrig.-Rev. Int. Froid 26 (5) (2003) 543–550.

[1008] H. Inaba, K. Matsuo, A. Horibe, Numerical simulation for fin effect of a rectangular latent heat storage vessel packed with molten salt under heat release process, Heat Mass Transfer 39 (3) (2003) 231–237.

[1009] P. Lamberg, K. Siren, Approximate analytical model for solidification in a finite PCM storage with internal fins, Appl. Math. Modell. 27 (7) (2003) 491–513.

[1010] M. Pinelli, S. Piva, Solid/liquid phase change in presence of natural convection: a thermal energy storage case study, J. Energy Resour. Technol.-Trans. ASME 125 (3) (2003) 190–198.

[1011] A. Sari, An experimental study on thermal characteristics of lauric acid as a latent heat storage material during melting process, Chin. J. Chem. Eng. 11 (2) (2003) 240–243.

[1012] M.R. Amin, N.L. Gawas, Conjugate heat transfer and effects of interfacial heat flux during the solidification process of continuous castings, J. Heat Transfer-Trans. ASME 125 (2) (2003) 339–348.

[1013] Z.W. Chen, Skin solidification during high pressure die casting of Al–11Si–2Cu–Fe alloy, Mater. Sci. Eng. A-Struct. Mater. Prop. Microstruct. Process. 348 (1–2) (2003) 145–153.

[1014] M.A. Gafur, M.N. Haque, K.N. Prabhu, Effect of chill thickness and superheat on casting/chill interfacial heat transfer during solidification of commercially pure aluminium, J. Mater. Process. Technol. 133 (3) (2003) 257–265.

[1015] W.D. Griffiths, K.N. Prabhu, C.P. Hallam, R. Kayikci, The deformation of the chill in experiments to determine the interfacial heat transfer coefficient during casting solidification, Int. J. Cast Metals Research 15 (5) (2003) 545–550.

[1016] M.Y. Ha, H.G. Lee, S.H. Seong, Numerical simulation of three-dimensional flow, heat transfer, and solidification of steel in continuous casting mold with electromagnetic brake, J. Mater. Process. Technol. 133 (3) (2003) 322–339.

[1017] F.M. Schmidt, Y. Le Maoult, S. Monteix, Modelling of infrared heating of thermoplastic sheet used in thermoforming process, J. Mater. Process. Technol. 143 (Special Issue SI) (2003) 225–231.

[1018] H.M. Si, C.D. Cho, S.Y. Kwahk, A hybrid method for casting process simulation by combining FDM and FEM with an efficient data conversion algorithm, J. Mater. Process. Technol. 133 (3) (2003) 311–321.

[1019] C. Sollogoub, Y. Demay, J.F. Agassant, Cast film problem: A non isothermal investigation, International Polymer Processing 18 (1) (2003) 80–86.

[1020] M.H. Chang, F.L. Chen, Stability characteristics of the mush affected by the solid layer below, J. Crystal Growth 255 (3–4) (2003) 369–378.

[1021] P.M. Pavel, N. Ene, Planar solidification solution with mushy zone, Energy Convers. Manage. 44 (18) (2003) 2977–2989.

[1022] C. Tangthieng, F.B. Cheung, Thermosolutal transport and macro segregation during freeze coating of a binary substance on a continuous moving object, Int. J. Heat Mass Transfer 46 (13) (2003) 2313–2327.

[1023] H.S. Udaykumar, S. Marella, S. Krishnan, Sharp-interface simulation of dendritic growth with convection: benchmarks, Int. J. Heat Mass Transfer 46 (14) (2003) 2615–2627.

[1024] S. Govender, Finite amplitude analysis of convection in rotating mushy layers during the solidification of binary alloys, J. Porous Media 6 (2) (2003) 137–147.

[1025] S. Chakraborty, N. Chakraborty, P. Kumar, P. Dutta, Studies on turbulent momentum, heat and species transport during binary alloy solidification in a top-cooled rectangular cavity, Int. J. Heat Mass Transfer 46 (7) (2003) 1115–1137.

[1026] S. Chakraborty, P. Dutta, Three-dimensional double-diffusive convection and macrosegregation during non-equilibrium solidification of binary mixtures, Int. J. Heat Mass Transfer 46 (12) (2003) 2115–2134.

[1027] W.Z. Dai, Z.W. Feng, R. Nassar, J. Palmer, A combined analytic and numerical method for predicting the solid-layer growth from melt crystallization, Numer. Heat Transfer Part A-Appl. 44 (6) (2003) 577–590.

[1028] A.I. Fedorchenko, A.A. Chernov, Simulation of the microstructure of a thin metal layer quenched from a liquid state, Int. J. Heat Mass Transfer 46 (5) (2003) 921–929.

[1029] C. Ghenai, A. Mudunuri, C.X. Lin, M.A. Ebadian, Double-diffusive convection during solidification of a metal analog system (NH_4Cl–H_2O) in a differentially heated cavity, Exp. Therm. Fluid Sci. 28 (1) (2003) 23–35.

[1030] J. Guo, C. Beckermann, Three-dimensional simulation of freckle formation during binary alloy solidification: effect of mesh spacing, Numer. Heat Transfer Part A-Appl. 44 (6) (2003) 559–576.

[1031] K.Y. Kim, Analysis of gap formation at mold–shell interface during solidification of aluminum alloy plate, ISIJ Int. 43 (5) (2003) 647–652.

[1032] S.G. Kim, W.T. Kim, T. Suzuki, Phase-field modeling of rapid solidification in small alloy droplets, ISIJ Int. 43 (11) (2003) 1758–1766.

[1033] R.A. Lambert, R.H. Rangel, Solidification of a supercooled liquid in stagnation-point flow, Int. J. Heat Mass Transfer 46 (21) (2003) 4013–4021.

[1034] C.W. Lan, Y.C. Chang, Efficient adaptive phase field simulation of directional solidification of a binary alloy, J. Crystal Growth 250 (3–4) (2003) 525–537.

[1035] L.H. Lewis, B. Nielsen, T. Friessnegg, V.J. Ghosh, M.J. Kramer, R.W. McCallum, K. Dennis, Nanostructural aspects, free volume and phase constitution of rapidly solidified Nd–Fe–B, J. Non-Crystall. Solids 315 (3) (2003) 256–270.

[1036] K. Li, B.Q. Li, H.C. de Groh, Effect of magnetic field on g-jitter induced convection and solute striation during solidification in space, Int. J. Heat Mass Transfer 46 (25) (2003) 4799–4811.

[1037] Z. Lipnicki, Role of the contact layer between liquid and solid on a solidification process, Int. J. Heat Mass Transfer 46 (12) (2003) 2149–2154.

[1038] T. Nishimura, J. Sasaki, T.T. Moo, The structure of plumes generated in the unidirectional solidification process for a binary system, Int. J. Heat Mass Transfer 46 (23) (2003) 4489–4497.

[1039] O.L. Rocha, C.A. Siqueira, A. Garcia, Cellular spacings in unsteady-state directionally solidified Sn–Pb alloys, Mater. Sci. Eng. A-Struct. Mater. Prop. Microstruct. Process. 361 (1–2) (2003) 111–118.

[1040] O.L. Rocha, C.A. Siqueira, A. Garcia, Heat flow parameters affecting dendrite spacings during unsteady-state solidification of Sn–Pb and Al–Cu alloys, Metall. Mater. Trans. A-Phys. Metall. Mater. Sci. 34A (4) (2003) 995–1006.

[1041] C.A. Siqueira, N. Cheung, A. Garcia, The columnar to equiaxed transition during solidification of Sn–Pb alloys, J. Alloys Comp. 351 (1–2) (2003) 126–134.

[1042] B.K. Soltan, M.M. Ardehali, Numerical simulation of water solidification phenomenon for ice-on-coil thermal energy storage application, Energy Convers. Manage. 44 (2003) 85–92.

[1043] C. Stelian, T. Duffar, I. Nicoara, Comparison between numerical simulation and experimental measurement of solute segregation during directional solidification, J. Crystal Growth 255 (1–2) (2003) 40–51.

[1044] P.S. Wei, C.C. Huang, K.W. Lee, Nucleation of bubbles on a solidification front—experiment and analysis, Metall. Mater. Trans. B-Process Metall. Mater. Process. Sci. 34 (3) (2003) 321–332.

[1045] M.H. Wu, A. Ludwig, A. Buhrig-Polaczek, M. Fehlbier, P.R. Sahm, Influence of convection and grain movement on globular equiaxed solidification, Int. J. Heat Mass Transfer 46 (15) (2003) 2819–2832.

[1046] R. Xu, G.F. Naterer, Controlling phase interface motion in inverse heat transfer problems with solidification, J. Thermophys. Heat Transfer 17 (4) (2003) 488–497.

[1047] F.B. Yeh, P.S. Wei, S.H. Chiu, Distinct property effects on rapid solidification of a thin, liquid layer on a substrate subject to self-consistent melting, J. Crystal Growth 247 (3–4) (2003) 563–575.

[1048] L. Braescu, A.M. Balint, S. Balint, The effect of a periodic movement on the die of the bottom line of the melt/gas meniscus in the case of edge-defined film-fed growth system, J. Crystal Growth 259 (1–2) (2003) 121–129.

[1049] T.M. Hansen, M. Radosevic, M. Kauffeld, T. Zwieg, Investigation of ice crystal growth and geometrical characteristics in ice slurry (RP-1166), Hvac&R Res. 9 (1) (2003) 19–32.

[1050] M. Kobayashi, T. Tsukada, M. Hozawa, Effect of wetting of melt against die surface on the edge-defined film-fed growth of oxide crystals, J. Crystal Growth 249 (1–2) (2003) 230–239.

[1051] K. Li, B.Q. Li, H.C. de Groh, Numerical analysis of double-diffusive convection/solidification under g-jitter/magnetic fields, J. Thermophys. Heat Transfer 17 (2) (2003) 199–209.

[1052] N. Ma, Solutal convection during growth of alloyed semiconductor crystals in a magnetic field, J. Thermophys. Heat Transfer 17 (1) (2003) 77–81.

[1053] S. Radhakrishnan, P.S. Sonawane, Role of heat transfer and thermal conductivity in the crystallization behavior of polypropylene-containing additives: a phenomenological model, J. Appl. Polym. Sci. 89 (11) (2003) 2994–2999.

[1054] G. Ratnieks, A. Muiznieks, A. Muhlbauer, Modelling of phase boundaries for large industrial FZ silicon crystal growth with the needle-eye technique, J. Crystal Growth 255 (3–4) (2003) 227–240.

[1055] D. Sun, H. Zhang, J. Kalejs, B. Mackintosh, An advanced multi-block method for the multiresolution modelling of EFG silicon tube growth, Modell. Simulat. Mater. Sci. Eng. 11 (1) (2003) 83–99.

[1056] J.X. Yun, Z.Q. Shen, Modeling of solid layer growth from melt for Taylor bubbles rising in a vertical crystallization tube, Chem. Eng. Sci. 58 (23–24) (2003) 5257–5268.

[1057] C.W. Lan, Three-dimensional simulation of floating-zone crystal growth of oxide crystals, J. Crystal Growth 247 (3–4) (2003) 597–612.

[1058] K. Lin, P. Dold, K.W. Benz, Optimization of thermal conditions during crystal growth in a multi-zone resistance furnace, Crystal Res. Technol. 38 (6) (2003) 419–428.

[1059] C.W. Lan, C.Y. Tu, Y.F. Lee, Effects of internal radiation on heat flow and facet formation in Bridgman growth of YAG crystals, Int. J. Heat Mass Transfer 46 (9) (2003) 1629–1640.

[1060] H. Zhang, D.J. Larson, C.L. Wang, T.H. Chen, Kinetics and heat transfer of CdZnTe Bridgman growth without wall contact, J. Crystal Growth 250 (1–2) (2003) 215–222.

[1061] E.N. Bystrova, V.V. Kalaev, O.V. Smirnova, E.V. Yakovlev, Y.N. Makarov, Prediction of the melt/crystal interface geometry in liquid encapsulated Czochralski growth of InP bulk crystals, J. Crystal Growth 250 (1–2) (2003) 189–194.

[1062] C.J. Jing, A. Hayashi, M. Kobayashi, T. Tsukada, M. Hozawa, N. Imaishi, K. Shimamura, N. Ichinose, Effect of internal radiative heat transfer on spoke pattern on oxide melt surface in Czochralski crystal growth, J. Crystal Growth 259 (4) (2003) 367–373.

[1063] C.J. Jing, M. Kobayashi, T. Tsukada, M. Hozawa, T. Fukuda, N. Imaishi, K. Shimamura, N. Ichinose, Effect of RF coil position on spoke pattern on oxide melt surface in Czochralski crystal growth, J. Crystal Growth 252 (4) (2003) 550–559.

[1064] K. Kakimoto, A. Tashiro, H. Ishii, T. Shinozaki, Mechanism of heat and oxygen transfer under electromagnetic CZ crystal growth with cusp-shaped magnetic fields, J. Electrochem. Soc. 150 (10) (2003) G648–G652.

[1065] V.V. Kalaev, I.Y. Evstratov, Y.N. Makarov, Gas flow effect on global heat transport and melt convection in Czochralski silicon growth, J. Crystal Growth 249 (1–2) (2003) 87–99.

[1066] V.V. Kalaev, D.P. Lukanin, V.A. Zabelin, Y.N. Makarov, J. Virbulis, E. Dornberger, W. von Ammon, Calculation of bulk defects in CZ Si growth: impact of melt turbulent fluctuations, J. Crystal Growth 250 (1–2) (2003) 203–208.

[1067] V. Kumar, G. Biswas, G. Brenner, F. Durst, Effect of thermocapillary convection in an industrial Czochralski crucible: numerical simulation, Int. J. Heat Mass Transfer 46 (9) (2003) 1641–1652.

[1068] A. Voigt, C. Weichmann, J. Nitschkowski, E. Dornberger, R. Holz, Transient and quasi-stationary simulation of heat and mass transfer in Czochralski silicon crystal growth, Crystal Res. Technol. 38 (6) (2003) 499–505.

[1069] E. Yakovlev, O.V. Smirnova, E.N. Bystrova, V.V. Kalaev, C. Frank-Rotsch, M. Neubert, P. Rudolph, Y.N. Makarov, Modeling analysis of VCz growth of GaAs bulk crystals using 3D unsteady melt flow simulations, J. Crystal Growth 250 (1–2) (2003) 195–202.

[1070] E.V. Yakovlev, V.V. Kalaev, E.N. Bystrova, O.V. Smirnova, Y.N. Makarov, C. Frank-Rotsch, M. Neubert, P. Rudolph, Modeling analysis of liquid encapsulated Czochralski growth of GaAs and InP crystals, Cryst. Res. Technol. 38 (6) (2003) 506–514.

[1071] E.V. Yakovlev, V.V. Kalaev, I.Y. Evstratov, C. Frank-Rotsch, M. Neubert, P. Rudolph, Y.N. Makarov, Global heat and mass transfer in vapor pressure controlled Czochralski growth of GaAs crystals, J. Crystal Growth 252 (1–3) (2003) 26–36.

[1072] V.S. Yuferev, O.N. Budenkova, M.G. Vasiliev, S.A. Rukolaine, V.N. Shlegel, Y.V. Vasiliev, A.I. Zhmakin, Variations of solid–liquid interface in the BGO low thermal gradients Cz growth for diffuse and specular crystal side surface, J. Crystal Growth 253 (1–4) (2003) 383–397.

[1073] J.S. Szmyd, K. Suzuki, Numerical analysis of transport phenomena in Y-Ba-Cu-O melt during growth of superconducting crystal Y123 by Czochralski method, Physica C 392 (Part 1) (2003) 446–452.

[1074] Z. Galazka, D. Schwabe, H. Wilke, Influence of internal radiation on the heat transfer during growth of YAG single crystals by the Czochralski method, Cryst. Res. Technol. 38 (10) (2003) 859–867.

[1075] D. Attinger, D. Poulikakos, On quantifying interfacial thermal resistance and surface energy during molten microdroplet surface deposition, Atomizat. Sprays 13 (2–3) (2003) 309–319.

[1076] M. Dietzel, S. Haferl, Y. Ventikos, D. Poulikakos, Marangoni and variable viscosity phenomena in picoliter size solder droplet deposition, J. Heat Transfer-Trans. ASME 125 (2) (2003) 365–376.

[1077] A.V. Freyberg, H. Henein, V. Uhlenwinkel, M. Buchholz, Droplet solidification and gas-droplet thermal coupling in the atomization of a Cu–6Sn alloy, Metall. Mater. Trans. B-Process Metall. Mater. Process. Sci. 34 (2) (2003) 243–253.

[1078] R. Ghafouri-Azar, J. Mostaghimi, S. Chandra, M. Charmchi, A stochastic model to simulate the formation of a thermal spray coating, J. Therm. Spray Technol. 12 (1) (2003) 53–69.

[1079] S. Haferl, D. Poulikakos, Experimental investigation of the transient impact fluid dynamics and solidification of a molten microdroplet pile-up, Int. J. Heat Mass Transfer 46 (2003) 535–550.

[1080] J.P. Hindmarsh, A.B. Russell, X.D. Chen, Experimental and numerical analysis of the temperature transition of a suspended freezing water droplet, Int. J. Heat Mass Transfer 46 (7) (2003) 1199–1213.

[1081] J. Mostaghimi, S. Chandra, R. Ghafouri-Azar, A. Dolatabadi, Modeling thermal spray coating processes: a powerful tool in design and optimization, Surf. Coat. Technol. 163 (2003) 1–11.

[1082] H. Nagai, Y. Nakata, M. Shibuya, T. Okutani, Synthesis of β-$FeSi_2$ by splat solidification in short-duration microgravity, Jpn. J. Appl. Phys. Part 1—-Regular Papers Short Notes & Review Papers 42 (4A) (2003) 1690–1693.

[1083] G.F. Naterer, Coupled liquid film and solidified layer growth with impinging supercooled droplets and Joule heating, Int. J. Heat Fluid Flow 24 (2) (2003) 223–235.

[1084] G.F. Naterer, Eulerian three-phase formulation with coupled droplet flow and multimode heat transfer, Numer. Heat Transfer B-Fundament. 43 (4) (2003) 331–352.

[1085] G.F. Naterer, Temperature gradient in the unfrozen liquid layer for multiphase energy balance with incoming droplets, J. Heat Transfer-Trans. ASME 125 (1) (2003) 186–189.

[1086] P. Shukla, N.S. Mishra, S.N. Ojha, Modeling of heat flow and solidification during atomization and spray deposition processing, J. Therm. Spray Technol. 12 (1) (2003) 95–100.

[1087] J.H. Zhao, D.M. Liu, H.Q. Ye, Modeling and simulation of the microstructure evolution of the gas-atomized alloy droplets during spray forming, J. Mater. Sci. Technol. 19 (5) (2003) 398–402.

[1088] M. Strub, O. Jabbour, F. Strub, J.P. Bedecarrats, Experimental study and modelling of the crystallization of a water droplet, Int. J. Refrig.-Rev. Int. Froid 26 (1) (2003) 59–68.

[1089] R. Ghafouri-Azar, S. Shakeri, S. Chandra, J. Mostaghimi, Interactions between molten metal droplets impinging on a solid surface, Int. J. Heat Mass Transfer 46 (8) (2003) 1395–1407.

[1090] N. Harris, A. McMillan, M. Holness, R. Uken, M. Watkeys, N. Rogers, A. Fallick, Melt generation and fluid flow in the thermal aureole of the Bushveld Complex, J. Petrol. 44 (6) (2003) 1031–1054.

[1091] P.F. Rey, P. Philippot, N. Thebaud, Contribution of mantle plumes, crustal thickening and greenstone blanketing to the 2.75–2.65 Ga global crisis, Precambrian Res. 127 (1–3) (2003) 43–60.

[1092] H.M. Koo, R. Vaillon, V. Goutiere, V. Le Dez, H. Cha, T.H. Song, Comparison of three discrete ordinates methods applied to two-dimensional curved geometries, Int. J. Therm. Sci. 42 (4) (2003) 343–359.

[1093] H.S. Li, G. Flamant, J.D. Lu, An alternative discrete ordinate scheme for collimated irradiation problems, Int. Commun. Heat Mass Transfer 30 (1) (2003) 61–70.

[1094] H.S. Li, G. Flamant, J.D. Lu, Mitigation of ray effects in the discrete ordinates method, Numer. Heat Transfer B-Fundament. 43 (5) (2003) 445–466.

[1095] H.S. Li, H.C. Zhou, J.D. Lu, C.G. Zheng, Computation of 2-D pinhole image-formation process of large-scale furnaces using the discrete ordinates method, J. Quantit. Spectrosc. Radiat. Transfer 78 (3–4) (2003) 437–453.

[1096] R.M.F. Vargas, A.V. Cardona, M.T. Vilhena, R.C. Barros, On the decomposition method applied to linear and non-linear discrete ordinates problems in slab geometry, Progress in Nuclear Energy 42 (4) (2003) 439–456.

[1097] S.M.H. Sarvari, J.R. Howell, S.H. Mansouri, A general method for estimation of boundary conditions over the surface of shields surrounded by radiating enclosures, Numer. Heat Transfer B-Fundament. 44 (1) (2003) 24–43.

[1098] H.K. Versteeg, J.C. Henson, W. Malalasekera, An adaptive angular quadrature for the discrete transfer method based on error estimation, J. Heat Transfer-Trans. ASME 125 (2) (2003) 301–311.

[1099] O. Guven, Y. Bayazitoglu, The radiative transfer solution of a rectangular enclosure using angular domain discrete wavelets, Int. J. Heat Mass Transfer 46 (4) (2003) 687–694.

[1100] K.J. Daun, D.P. Morton, J.R. Howell, Geometric optimization of radiant enclosures containing specular surfaces, J. Heat Transfer-Trans. ASME 125 (5) (2003) 845–851.

[1101] M.F. Modest, Backward Monte Carlo simulations in radiative heat transfer, J. Heat Transfer-Trans. ASME 125 (1) (2003) 57–62.

[1102] J.C. Chai, One-dimensional transient radiation heat transfer modeling using a finite-volume method, Numer. Heat Transfer B-Fundament. 44 (2) (2003) 187–208.

[1103] D.Y. Byun, Investigation of radiative heat transfer in complex geometries using blocked-off, multiblock, and embedded boundary treatments, Numer. Heat Transfer Part A-Appl. 43 (8) (2003) 807–825.

[1104] M.N. Borjini, H. Farhat, M.S. Radhouani, Analysis of radiative heat transfer in a partitioned idealized furnace, Numer. Heat Transfer Part A-Appl. 44 (2) (2003) 199–218.

[1105] H.M. Park, M.C. Sung, Sequential solution of a three-dimensional inverse radiation problem, Comput. Methods Appl. Mech. Eng. 192 (33–34) (2003) 3689–3704.

[1106] K.J. Daun, J.R. Howell, D.P. Morton, Geometric optimization of radiative enclosures through nonlinear programming, Numer. Heat Transfer B-Fundament. 43 (3) (2003) 203–219.

[1107] X. Lu, P.F. Hsu, Parallel computing of an integral formulation of transient radiation transport, J. Thermophys. Heat Transfer 17 (4) (2003) 425–433.

[1108] J. Tal, R. Ben-Zvi, A. Kribus, A high-efficiency parallel solution of the radiative transfer equation, Numer. Heat Transfer B-Fundament. 44 (3) (2003) 295–308.

[1109] S. Sakai, S. Maruyama, A fast approximated method of radiative exchange for combined heat transfer simulation, Numer. Heat Transfer B-Fundament. 44 (5) (2003) 473–487.

[1110] W.X. Tian, W.K.S. Chiu, Calculation of direct exchange areas for nonuniform zones using a reduced integration scheme, J. Heat Transfer-Trans. ASME 125 (5) (2003) 839–844.

[1111] S.P. Song, B.Q. Li, Boundary integral solution of thermal radiation exchanges in axisymmetric furnaces, Numer. Heat Transfer B-Fundament. 44 (5) (2003) 489–507.

[1112] B. Dubroca, M. Frank, A. Klar, G. Thommes, A half space moment approximation to the radiative heat transfer equations, Zeitschrift fur Angewandte Mathematik und Mechanik 83 (12) (2003) 853–858.

[1113] M. Tadi, Inverse evaluation of emissivity function, Heat Mass Transfer 40 (1–2) (2003) 15–23.

[1114] D.E. Anderson, T.E. Truslove, J. Kubie, Thermal modelling and optimization of heat transfer in a high-temperature theatre luminaire, Proc. Inst. Mech. Eng. Part C-Journal of Mechanical Eng. Science 217 (9) (2003) 1039–1048.

[1115] P. Chaudhuri, D.C. Reddy, P. Santra, S. Khirwadkar, N.R. Pragash, Y.C. Saxena, Study of radiation heat transfer between PFC and vacuum vessel during SST-1 baking, Fusion Eng. and Design 65 (1) (2003) 119–132.

[1116] Y. Zheng, R.S. Barlow, J.P. Gore, Spectral radiation properties of partially premixed turbulent flames, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1065–1073.

[1117] Y. Zheng, R.S. Barlow, J.P. Gore, Measurements and calculations of spectral radiation intensities for turbulent non-premixed and partially premixed flames, J. Heat Transfer-Trans. ASME 125 (4) (2003) 678–686.

[1118] G.W. Xu, M. Ikegami, S. Honma, K. Ikeda, X.X. Ma, H. Nagaishi, D.L. Dietrich, P.M. Struk, Inverse influence of initial diameter on droplet burning rate in cold and hot ambiences: a thermal action of flame in balance with heat loss, Int. J. Heat Mass Transfer 46 (7) (2003) 1155–1169.

[1119] Z. Wen, S. Yun, M.J. Thomson, M.F. Lightstone, Modeling soot formation in turbulent kerosene/air jet diffusion flames, Combust. Flame 135 (3) (2003) 323–340.

[1120] P.J. Coelho, O.J. Teerling, D. Roekaerts, Spectral radiative effects and turbulence/radiation interaction in a non-luminous turbulent jet diffusion flame, Combust. Flame 133 (1–2) (2003) 75–91.

[1121] O.J. Kim, J.P. Gore, R. Viskanta, X.L. Zhu, Prediction of self-absorption in opposed flow diffusion and partially premixed flames using a weighted sum of gray gases model (WSGGM)-based spectral model, Numer. Heat Transfer Part A-Appl. 44 (4) (2003) 335–353.

[1122] G. Li, M.F. Modest, Importance of turbulence radiation interactions in turbulent diffusion jet flames, J. Heat Transfer-Trans. ASME 125 (5) (2003) 831–838.

[1123] J.L. Consalvi, B. Porterie, J.C. Loraud, Method for computing the interaction of fire environment and internal solid regions, Numer. Heat Transfer Part A-Appl. 43 (8) (2003) 777–805.

[1124] A.L. Sullivan, P.F. Ellis, I.K. Knight, A review of radiant heat flux models used in bushfire applications, Int. J. Wildland Fire 12 (1) (2003) 101–110.

[1125] W.W. Yuen, S. Han, W.K. Chow, The effect of thermal radiation on the dynamics of flashover in a compartment fire, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (4) (2003) 528–538.

[1126] J.F. Widmann, Evaluation of the planck mean absorption coefficients for radiation transport through smoke, Combust. Sci. Technol. 175 (12) (2003) 2299–2308.

[1127] J.L. Consalvi, B. Porterie, J.C. Loraud, On the use of gray assumption for modeling thermal radiation through water sprays, Numer. Heat Transfer Part A-Appl. 44 (5) (2003) 505–519.

[1128] P.J. Coelho, P. Perez, M. El Hafi, Benchmark numerical solutions for radiative heat transfer in two-dimensional axisymmetric enclosures with nongray sooting media, Numer. Heat Transfer B-Fundament. 43 (5) (2003) 425–444.

[1129] J.F. Wiedenhoefer, R.D. Reitz, A multidimensional radiation model for diesel engine simulation with comparison to experiment, Numer. Heat Transfer Part A-Appl. 44 (7) (2003) 665–682.

[1130] S. Dembele, J.X. Wen, Evaluation of a fast correlated-k approach for radiation calculations in combustion systems, Numer. Heat Transfer B-Fundament. 44 (4) (2003) 365–385.

[1131] T. Takata, A. Yamaguchi, I. Mackawa, Numerical investigation of multi-dimensional characteristics in sodium combustion, Nuclear Eng. and Design 220 (1) (2003) 37–50.

[1132] H.M. Zhang, M.F. Modest, Full-spectrum k-distribution correlations for carbon dioxide mixtures, J. Thermophys. Heat Transfer 17 (2) (2003) 259–263.

[1133] H.M. Zhang, M.F. Modest, Multi-group full-spectrum k-distribution database for water vapor mixtures in radiative transfer calculations, Int. J. Heat Mass Transfer 46 (19) (2003) 3593–3603.

[1134] H.M. Zhang, M.F. Modest, Scalable multi-group full-spectrum correlated-k distributions for radiative transfer calculations, J. Heat Transfer-Trans. ASME 125 (3) (2003) 454–461.

[1135] M.F. Modest, Narrow-band and full-spectrum k-distributions for radiative heat transfer- correlated-k vs. scaling approximation, J. Quantit. Spectrosc. Radiat. Transfer 76 (1) (2003) 69–83.

[1136] S. Matsuyama, T. Sakai, A. Sasoh, K. Sawada, Parallel computation of fully coupled hypersonic radiating flowfield using multiband model, J. Thermophys. Heat Transfer 17 (1) (2003) 21–28.

[1137] Y. Huang, X.L. Xia, H.P. Tan, Comparison of two methods for solving radiative heat transfer in a gradient index semitransparent slab, Numer. Heat Transfer B-Fundament. 44 (1) (2003) 83–99.

[1138] J.F. Luo, H.P. Tan, L.M. Ruan, T.W. Tong, Refractive index effects on heat transfer in multilayer scattering composite, J. Thermophys. Heat Transfer 17 (3) (2003) 407–419.

[1139] H.P. Tan, J.F. Luo, L.M. Ruan, Q.Z. Yu, Transient coupled heat transfer in a multi-layer composite with opaque specular surfaces and semitransparent specular interfaces, Int. J. Therm. Sci. 42 (2) (2003) 209–222.

[1140] H.P. Tan, Y. Huang, X.L. Xia, Solution of radiative heat transfer in a semitransparent slab with an arbitrary refractive index distribution and diffuse gray boundaries, Int. J. Heat Mass Transfer 46 (11) (2003) 2005–2014.

[1141] L.H. Liu, H.P. Tan, Q.Z. Yu, Temperature distributions in an absorbing-emitting-scattering semitransparent slab with variable spatial refractive index, Int. J. Heat Mass Transfer 46 (15) (2003) 2917–2920.

[1142] H.P. Tan, J.F. Luo, X.L. Xia, Q.Z. Yu, Transient coupled heat transfer in multilayer composite with one specular boundary coated, Int. J. Heat Mass Transfer 46 (4) (2003) 731–747.

[1143] Y.H. Zhou, Z.M. Zhang, Radiative properties of semitransparent silicon wafers with rough surfaces, J. Heat Transfer-Trans. ASME 125 (3) (2003) 462–470.

[1144] M. Junk, A. Unterreiter, F. Zingsheim, A hybrid simulation method for radiative transfer equations, European Journal of Applied Mathematics 14 (Part 2) (2003) 165–179.

[1145] L.H. Liu, Domain isolation concept for solution of radiative transfer in large-scale semitransparent media, J. Quantit. Spectrosc. Radiat. Transfer 78 (3–4) (2003) 373–379.

[1146] M. Falcone, S. Lopez-Pouso, Analysis and comparison of two approximation schemes for a radiative transfer system, Math. Models Meth. Appl. Sci. 13 (2) (2003) 159–186.

[1147] A.R. Deghiedy, M. Sallah, M. Abdou, Radiative transfer in random media with Rayleigh scattering, J. Quantit. Spectrosc. Radiat. Transfer 76 (3–4) (2003) 359–372.

[1148] Z. Altac, M. Tekkalmaz, The synthetic kernel (SKN) method applied to thermal radiative transfer in absorbing, emitting, and isotropically scattering homogeneous and inhomogeneous solid spherical medium, J. Heat Transfer-Trans. ASME 125 (4) (2003) 739–746.

[1149] J.B. Hao, L.M. Luan, H.P. Tan, Effect of anisotropic scattering on radiative heat transfer in two-dimensional rectangular media, J. Quantit. Spectrosc. Radiat. Transfer 78 (2) (2003) 151–161.

[1150] P. Rath, S.C. Mishra, P. Mahanta, U.K. Saha, K. Mitra, Discrete transfer method applied to transient radiative transfer problems in participating medium, Numer. Heat Transfer Part A-Appl. 44 (2) (2003) 183–197.

[1151] N. Selcuk, I. Ayranci, The method of lines solution of the discrete ordinates method for radiative heat transfer in enclosures containing scattering media, Numer. Heat Transfer B-Fundament. 43 (2) (2003) 179–201.

[1152] X.L. Chen, W.H. Sutton, Radiative transfer in finite cylindrical media using transformed integral equations, J. Quantit. Spectrosc. Radiat. Transfer 77 (3) (2003) 233–271.

[1153] F. Asllanaj, G. Jeandel, J.R. Roche, D. Schmitt, Existence and uniqueness of a steady state solution of a coupled radiative–conductive heat transfer problem for a non-grey anisotropically and participating medium, Transport Theory and Statistical Physics 32 (1) (2003) 1–35.

[1154] H.M. Park, W.J. Lee, An inverse radiation problem of simultaneous estimation of heat transfer coefficient and absorption coefficient in participating media, Int. J. Numer. Methods Eng. 56 (6) (2003) 787–807.

[1155] S.M.H. Sarvari, S.H. Mansouri, J.R. Howell, Inverse boundary design radiation problem in absorbing-emitting media with irregular geometry, Numer. Heat Transfer Part A-Appl. 43 (6) (2003) 565–584.

[1156] C. De Micco, C.M. Aldao, On the net radiation method for heat transfer, European Journal of Physics 24 (1) (2003) 81–89.

[1157] T.D. Bennett, Complex combination solution for radiation-conduction transport with periodic boundary conditions, Int. J. Heat Mass Transfer 46 (13) (2003) 2341–2351.

[1158] P.M. Jordan, A nonstandard finite difference scheme for nonlinear heat transfer in a thin finite rod, J. Difference Equations Appl. 9 (11) (2003) 1015–1021.

[1159] S.C. Mishra, P. Talukdar, D. Trimis, F. Durst, Computational efficiency improvements of the radiative transfer problems with or without conduction—a comparison of the collapsed dimension method and the discrete transfer method, Int. J. Heat Mass Transfer 46 (16) (2003) 3083–3095.

[1160] S.M.H. Sarvari, J.R. Howell, S.H. Mansouri, Inverse boundary design conduction-radiation problem in irregular two-dimensional domains, Numer. Heat Transfer B-Fundament. 44 (3) (2003) 209–224.

[1161] M.T. Vilhena, M. Thompson, R.P. Pazos, L.E. Ourique, Qualitative analysis of the S-N approximations of the transport equation and combined conduction-radiation heat transfer problem in a slab, Progress in Nuclear Energy 42 (4) (2003) 427–437.

[1162] P. Talukdar, S.C. Mishra, Transient conduction-radiation interaction in a planar packed bed with variable porosity, Numer. Heat Transfer Part A-Appl. 44 (3) (2003) 281–297.

[1163] X. Zhang, F. Yu, W. Wu, Y. Zuo, Application of radial effective thermal conductivity for heat transfer model of steel coils in HPH furnace, Int. J. Thermophys. 24 (5 Special Issue SI) (2003) 1395–1405.

[1164] T. Badinand, T.H. Fransson, Radiative heat transfer in film-cooled liquid rocket engine nozzles, J. Thermophys. Heat Transfer 17 (1) (2003) 29–34.

[1165] E.M. Sparrow, J.P. Abraham, A computational analysis of the radiative and convective processes that take place in preheated and non-preheated ovens, Heat Transfer Eng. 24 (5) (2003) 25–37.

[1166] E. Sediki, A. Soufiani, M.S. Sifdoui, Combined gas radiation and laminar mixed convection in vertical circular tubes, Int. J. Heat Fluid Flow 24 (5) (2003) 736–746.

[1167] C.H. Chiu, C.K. Chen, Application of Adomian's decomposition procedure to the analysis of convective–radiative fins, J. Heat Transfer-Trans. ASME 125 (2) (2003) 312–316.

[1168] C.K. Krishnaprakas, K.B. Narayana, Heat transfer analysis of mutually irradiating fins, Int. J. Heat Mass Transfer 46 (5) (2003) 761–769.

[1169] J. Monnier, Shape sensitivities in a Navier–Stokes flow with convective and grey bodies radiative thermal transfer, Opt. Control Appl. Meth. 24 (5) (2003) 237–256.

[1170] B. Dussoubs, J. Jourde, F. Patisson, J.L. Houzelot, D. Ablitzer, Modelling of a moving bed furnace for the production of uranium tetrafluoride, Part 1: Formulation of the model, Chem. Eng. Sci. 58 (12) (2003) 2617–2627.

[1171] J. Aschaber, C. Hebling, J. Luther, Realistic modelling of TPV systems, Semiconductor Sci. Technol. 18 (5) (2003) S158–S164.

[1172] C.J. Fu, Z.M. Zhang, Transmission enhancement using a negative-refraction layer, Microscale Thermophysical Eng. 7 (3) (2003) 221–234.

[1173] A.I. Volokitin, B.N.J. Persson, Adsorbate vibrational mode enhancement of radiative heat transfer, JETP Letters 78 (7) (2003) 457–460.

[1174] T. Hassan, K.R. Naqvi, S.A. El-Waki, E.M. Abulwafa, Transient radiative heat transfer through thin films using Laguerre-Galerkin method, J. Physics D-Applied Physics 36 (23) (2003) 3014–3026.

[1175] J. Liu, S.J. Zhang, Y.S. Chen, Prediction of radiative properties of patterned silicon wafers by solving Maxwell's equations in the time domain, Numer. Heat Transfer B-Fundament. 44 (4) (2003) 329–345.

[1176] L.H. Liu, Multiple size group analysis for transient radiative heating of particle polydispersions, J. Quantit. Spectrosc. Radiat. Transfer 76 (2) (2003) 225–234.

[1177] L.H. Liu, Effects of local non-uniform particle temperature on radiative heat transfer in particulate systems, Heat Mass Transfer 39 (10) (2003) 849–851.

[1178] L.H. Liu, A concept of multi-scale modeling for radiative heat transfer in particle polydispersions, J. Quantit. Spectrosc. Radiat. Transfer 78 (2) (2003) 227–233.

[1179] J.B. Hargrove, J.R. Lloyd, C.J. Radcliffe, Radiative heat transfer properties of electro-controllable fluids, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1058–1064.

[1180] B.K. Wiseman, J.A. Khan, Evaluation of the radiative properties of a dispersed particulate medium for construction material applications, Int. J. Heat Mass Transfer 46 (12) (2003) 2291–2303.

[1181] M.A. Sanchez, W.H. Sutton, Determination of reflectance function for aluminum and stainless-steel foil surfaces, J. Thermophys. Heat Transfer 17 (4) (2003) 434–441.

[1182] F. Alhama, J. Zueco, C.F. Gonzalez-Fernandez, An inverse determination of unsteady heat fluxes using a network simulation method, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1178–1183.

[1183] Z. Cheng, M. Paraschivoiu, Parallel computations of finite element output bounds for conjugate heat transfer, Finite Elements Anal. Design 39 (7) (2003) 581–597.

[1184] E. Divo, A.J. Kassab, F. Rodriguez, Parallel domain decomposition approach for large-scale three-dimensional boundary-element models in linear and nonlinear heat conduction, Numer. Heat Transfer B-Fundament. 44 (5) (2003) 417–437.

[1185] A.F. Khadrawi, M.A. Al-Nimr, A perturbation technique to solve conjugated heat transfer problems in circular ducts, Heat Mass Transfer 39 (2) (2003) 125–130.

[1186] J. Pasdunkorale, I.W. Turner, A second order finite volume technique for simulating transport in anisotropic media, Int. J. Numer. Methods Heat Fluid Flow 13 (1) (2003) 31–56.

[1187] S. Phongthanapanich, P. Dechaumphai, Adaptive Delaunay triangulation for steady-state and transient heat transfer analyses, Indian J. Eng. Mater. Sci. 10 (4) (2003) 245–260.

[1188] C.H. Cheng, M.H. Chang, Shape identification by inverse heat transfer method, J. Heat Transfer-Trans. ASME 125 (2) (2003) 224–231.

[1189] P. Duda, Solution of multidimensional inverse heat conduction problem, Heat Mass Transfer 40 (1–2) (2003) 115–122.

[1190] C.H. Huang, C.Y. Yeh, H.R.B. Orlande, A nonlinear inverse problem in simultaneously estimating the heat and mass production rates for a chemically reacting fluid, Chem. Eng. Sci. 58 (16) (2003) 3741–3752.

[1191] S. Kim, B.J. Chung, M.C. Kim, K.Y. Kim, Inverse estimation of temperature-dependent thermal conductivity and heat capacity per unit volume with the direct integration approach, Numer. Heat Transfer Part A-Appl. 44 (5) (2003) 521–535.

[1192] S.K. Kim, B.S. Jung, H.J. Kim, W.I. Lee, Inverse estimation of thermophysical properties for anisotropic composite, Exp. Therm. Fluid Sci. 27 (6) (2003) 697–704.

[1193] S.K. Kim, I.M. Daniel, Solution to inverse heat conduction problem in nanoscale using sequential method, Numer. Heat Transfer B-Fundament. 44 (5) (2003) 439–456.

[1194] S. Kim, M.C. Kim, K.Y. Kim, Non-iterative estimation of temperature-dependent thermal conductivity without internal measurements, Int. J. Heat Mass Transfer 46 (2003) 1801–1810.

[1195] S.K. Kim, J.S. Lee, W.I. Lee, A solution method for a nonlinear three-dimensional inverse heat conduction problem using the sequential gradient method combined with cubic-spline function specification, Numer. Heat Transfer B-Fundament. 43 (1) (2003) 43–61.

[1196] S.K. Kim, W.I. Lee, A maximum entropy solution for a two-dimensional inverse heat conduction problem, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1197–1205.

[1197] H.Y. Li, W.M. Yan, Identification of wall heat flux for turbulent forced convection by inverse analysis, Int. J. Heat Mass Transfer Mass Transfer 46 (6) (2003) 1041–1048.

[1198] X.W. Ling, R.G. Keanini, H.P. Cherukuri, A non-iterative finite element method for inverse heat conduction problems, Int. J. Numer. Methods Eng. 56 (9) (2003) 1315–1334.

[1199] M. Vynnycky, J. Ferrari, N. Lior, Some analytical and numerical solutions to inverse problems applied to optimizing phase-transformation tracking in gas quenching, J. Heat Transfer-Trans. ASME 125 (1) (2003) 1–10.

[1200] C.Y. Yang, Estimation of boundary conditions in nonlinear inverse heat conduction problems, J. Thermophys. Heat Transfer 17 (3) (2003) 389–395.

[1201] J. Caldwell, A.W. Date, Implicit enthalpy formulation of phase-change problems on unstructured grid, Commun. Numer. Methods Eng. 19 (11) (2003) 865–875.

[1202] J. Caldwell, Y.Y. Kwan, On the perturbation method for the Stefan problem with time-dependent boundary conditions, Int. J. Heat Mass Transfer 46 (8) (2003) 1497–1501.

[1203] J. Caldwell, S. Savovic, Y.Y. Kwan, Nodal integral and finite difference solution of one-dimensional Stefan problem, J. Heat Transfer-Trans. ASME 125 (3) (2003) 523–527.

[1204] C.Y. Li, S.V. Garimella, J.E. Simpson, Fixed-grid front-tracking algorithm for solidification problems, Part I: Method and validation, Numer. Heat Transfer B-Fundament. 43 (2) (2003) 117–141.

[1205] C.Y. Li, S.V. Garimella, J.E. Simpson, Fixed-grid front-tracking algorithm for solidification problems, Part II: Directional solidification with melt convection, Numer. Heat Transfer B-Fundament. 43 (2) (2003) 143–166.

[1206] M. Ayub, A. Masud, A new stabilized formulation for convective-diffusive heat transfer, Numer. Heat Transfer B-Fundament. 44 (1) (2003) 1–23.

[1207] C. Kavouklis, G.F. Carey, Linear feedback control for convection-diffusion, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 365–382.

[1208] M.S. Darwish, F. Moukalled, TVD schemes for unstructured grids, Int. J. Heat Mass Transfer 46 (4) (2003) 599–611.

[1209] M. Darbandi, G.E. Schneider, Thermobuoyancy treatment for electronic packaging using an improved advection scheme, J. Electron. Packag. 125 (2) (2003) 244–250.

[1210] T.H. Park, H.G. Choi, J.Y. Yoo, S.J. Kim, Streamline upwind numerical simulation of two-dimensional confined impinging slot jets, Int. J. Heat Mass Transfer 46 (2003) 251–262.

[1211] H.I. Choi, D. Lee, J.S. Maeng, A node-centered pressure-based method for all speed flows on unstructured grids, Numer. Heat Transfer B-Fundament. 44 (2) (2003) 165–185.

[1212] S.K. Choi, S.O. Kim, C.H. Lee, H.K. Choi, Use of the momentum interpolation method for flows with a large body force, Numer. Heat Transfer B-Fundament. 43 (3) (2003) 267–287.

[1213] M. Darbandi, S.F. Hosseinizadeh, General pressure-correction strategy to include density variation in incompressible algorithms, J. Thermophys. Heat Transfer 17 (3) (2003) 372–380.

[1214] A.W. Date, Fluid dynamical view of pressure checkerboarding problem and smoothing pressure correction on meshes with colocated variables, Int. J. Heat Mass Transfer 46 (25) (2003) 4885–4898.

[1215] V. Heuveline, On higher-order mixed FEM for low Mach number flows: application to a natural convection benchmark problem, Int. J. Numer. Methods Fluids 41 (12) (2003) 1339–1356.

[1216] G.B. Jacobs, D.A. Kopriva, F. Mashayek, A comparison of outflow boundary conditions for the multidomain staggered-grid spectral method, Numer. Heat Transfer B-Fundament. 44 (3) (2003) 225–251.

[1217] R.G. Jia, B. Sunden, Multiblock implementation strategy for a 3-D pressure-based flow and heat transfer solver, Numer. Heat Transfer B-Fundament. 44 (5) (2003) 457–472.

[1218] C.H. Liu, D.Y.C. Leung, C.M. Woo, Development of a scalable finite element solution to the Navier–Stokes equations, Computational Mechanics 32 (3) (2003) 185–198.

[1219] M.T. Manzari, A time-accurate finite element algorithm for incompressible flow problems, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 158–177.

[1220] P. Nithiarasu, An efficient artificial compressibility (AC) scheme based on the characteristic based split (CBS) method for incompressible flows, Int. J. Numer. Methods Eng. 56 (13) (2003) 1815–1845.

[1221] C. Nonino, A simple pressure stabilization for a SIMPLE-like equal-order FEM algorithm, Numer. Heat Transfer B-Fundament. 44 (1) (2003) 61–81.

[1222] W.Z. Shen, J.A. Michelsen, N.N. Sorensen, J.N. Sorensen, An improved SIMPLEC method on collocated grids for steady and unsteady flow computations, Numer. Heat Transfer B-Fundament. 43 (3) (2003) 221–239.

[1223] T.W.H. Sheu, R.K. Lin, An incompressible Navier–Stokes model implemented on nonstaggered grids, Numer. Heat Transfer B-Fundament. 44 (3) (2003) 277–294.

[1224] J.J. Wei, B. Yu, W.Q. Tao, Y. Kawaguchi, H.S. Wang, A new high-order-accurate and bounded scheme for incompressible flow, Numer. Heat Transfer B-Fundament. 43 (1) (2003) 19–41.

[1225] S.M. Kang, Y. Kim, Parallel unstructured-grid finite-volume method for turbulent nonpremixed flames using the flamelet model, Numer. Heat Transfer B-Fundament. 43 (6) (2003) 525–547.

[1226] V.I. Mazhukin, I. Smurov, A.V. Shapranov, M.M. Demin, The method of constructing dynamically adapting grids for problems of unstable laminar combustion, Numer. Heat Transfer B-Fundament. 44 (4) (2003) 387–415.

[1227] B. Baudouy, Kapitza resistance and thermal conductivity of Kapton in superfluid helium, Cryogenics 43 (12) (2003) 667–672.

[1228] A. Bhattacharya, R.L. Mahajan, Temperature dependence of thermal conductivity of biological tissues, Physiological Measurement 24 (3) (2003) 769–783.

[1229] C. Bonacina, M. Campanale, L. Moro, Analytical and experimental investigations on the heat transfer properties of light concrete, Int. J. Thermophys. 24 (5 Special Issue SI) (2003) 1407–1414.

[1230] S.D. George, S. Augustine, E. Mathai, P. Radhakrishnan, V.P.N. Nampoori, C.P.G. Vallabhan, Effect of Te doping on thermal diffusivity of Bi2Se3 crystals: A study using open cell photoacoustic technique, Physica Status Solidi A-Applied Research 196 (2) (2003) 384–389.

[1231] C.D. Martinsons, A.P. Levick, G.J. Edwards, Measurement of the thermal diffusivity of solids with an improved accuracy, Int. J. Thermophys. 24 (4) (2003) 1171–1183.

[1232] H.F. Zhang, L.Q. He, S.X. Cheng, Z.T. Zhai, D.Y. Gao, A dual-thermistor probe for absolute measurement of thermal diffusivity and thermal conductivity by the heat pulse method, Measurem. Sci. Technol. 14 (8) (2003) 1396–1401.

[1233] G.P. Joshi, N.S. Saxena, T.P. Sharma, S. Verma, V. Dixit, S.C.K. Mishra, Measurement of thermal properties of polyaniline/metal from room temperature to 170 degrees C, J. Appl. Polym. Sci. 90 (2) (2003) 430–435.

[1234] M. Anis-ur-Rehman, A. Maqsood, Measurement of thermal transport properties with an improved transient plane source technique, Int. J. Thermophys. 24 (3) (2003) 867–883.

[1235] P. Jeon, K. Lee, J. Yoo, Y. Park, J. Lee, Measurement of thermal diffusivity using deformation gradient and phase in the photothermal displacement technique, KSME Int. J. 17 (12) (2003) 2078–2086.

[1236] R. Eriksson, M. Hayashi, S. Seetharaman, Thermal diffusivity measurements of liquid silicate melts, Int. J. Thermophys. 24 (3) (2003) 785–797.

[1237] J.A. Balderas-Lopez, Measurements of the thermal effusivity of transparent liquids by means of a photopyroelectric technique, Revista Mexicana de Fisica 49 (4) (2003) 353–357.

[1238] J.A. Balderas-Lopez, A. Mandelis, New photopyroelectric technique for precise measurements of the thermal effusivity of transparent liquids, Int. J. Thermophys. 24 (2) (2003) 463–471.

[1239] S.K. Das, N. Putra, P. Thiesen, W. Roetzel, Temperature dependence of thermal conductivity enhancement for nanofluids, J. Heat Transfer-Trans. ASME 125 (4) (2003) 567–574.

[1240] L. Shi, D.Y. Li, C.H. Yu, W.Y. Jang, D. Kim, Z. Yao, P. Kim, A. Majumdar, Measuring thermal and thermoelectric properties of one-dimensional nanostructures using a microfabricated device, J. Heat Transfer-Trans. ASME 125 (5) (2003) 881–888.

[1241] O.I. Purskii, N.N. Zholonko, V.A. Konstantinov, Influence of rotational motion of molecules on the thermal conductivity of solid SF6, CHCl3, C6H6, and CCl4, Low Temperature Physics 29 (9–10) (2003) 771–775.

[1242] M. Lazard, S. Andre, D. Maillet, Thermal characterization of semi-transparent media: measurement of phononic diffusivity of glass and silica, Eur. Phys. J.-Applied Physics 23 (3) (2003) 207–211.

[1243] D.S. Smith, S. Fayette, S. Grandjean, C. Martin, R. Telle, T. Tonnessen, Thermal Resistance of Grain Boundaries in Alumina Ceramics and Refractories, J. the American Ceramic Society 86 (1) (2003) 105–111.

[1244] M.P. Jarvinen, R. Zevenhoven, E.K. Vakkilainen, M. Forssen, Effective thermal conductivity and internal thermal radiation in burning black liquor particles, Combust. Sci. Technol. 175 (5) (2003) 873–900.

[1245] B. Gibert, F.R. Schilling, A. Tommasi, D. Mainprice, Thermal diffusivity of olivine single-crystals and polycrystalline aggregates at ambient conditions—a comparison—art. no. 2172, Geophys. Res. Lett. 30 (22) (2003) 2172.

[1246] S. Augustine, J. Ravi, S. Ampili, T.M.A. Rasheed, K.P.R. Nair, T. Endo, E. Mathai, Effect of Te doping and electron irradiation on thermal diffusivity of Bi_2Se_3 thin films by photo-thermal technique, J. Phys. D-Appl. Phys. 36 (8) (2003) 994–1000.

[1247] S.D. George, P. Radhakrishnan, V.P.N. Nampoori, C.P.G. Vallabhan, Photothermal deflection measurement on heat transport in GaAs epitaxial layers—art. no. 165319, Phys. Rev. B 6816 (16) (2003) 5319.

[1248] S.D. George, P. Radhakrishnan, V.P.N. Nampoori, C.P.G. Vallabhan, Thermal characterization of intrinsic and extrinsic InP using photoacoustic technique, J. Phys. D-Appl. Phys. 36 (8) (2003) 990–993.

[1249] S.H. Choi, S. Maruyama, K.K. Kim, J.H. Lee, Evaluation of the phonon mean free path in thin films by using classical molecular dynamics, J. Korean Phys. Soc. 43 (5 Part 1) (2003) 747–753.

[1250] G.D. Verros, S. Papahristou, J. Prinos, N.A. Malamataris, Computer-aided estimation of acetone, methyl acetate, and chloroform diffusion coefficients in poly(vinyl acetate), Chem. Eng. Commun. 190 (3) (2003) 334–359.

[1251] J.P. Kizito, J.I.D. Alexander, R.M. Banish, Transient convective effects on diffusion measurements in liquids, J. Thermophys. Heat Transfer 17 (2) (2003) 186–192.

[1252] K. Azaar, J.M. Vergnaud, I.D. Rosca, Anisotropic swelling of EPDM rubber discs by absorption of toluene, Rubber Chem. Technol. 76 (4) (2003) 1031–1044.

[1253] P.N.L. Lens, R. Gastesi, F. Vergeldt, A.C. van Aelst, A.G. Pisabarro, H. Van As, Diffusional properties of methanogenic granular sludge: H-1 NMR characterization, Appl. Environ. Microbiol. 69 (11) (2003) 6644–6649.

[1254] B. Gibert, U. Seipold, A. Tommasi, D. Mainprice, Thermal diffusivity of upper mantle rocks: Influence of temperature, pressure, and the deformation fabric—art. no. 2359, J. Geophys. Res.-Solid Earth 108 (B8) (2003) 2359.

[1255] S. Zohoun, E. Agoua, G. Degan, P. Perre, An experimental correction proposed for an accurate determination of mass diffusivity of wood in steady regime, Heat Mass Transfer 39 (2) (2003) 147–155.

[1256] E. Marin, O. Delgado-Vasallo, H. Valiente, A temperature relaxation method for the measurement of the specific heat of solids at room temperature in student laboratories, Am. J. Phys. 71 (10) (2003) 1032–1036.

[1257] J. Sempere, R. Nomen, E. Serra, J. Sales, Temperature oscillating mini-calorimeter, J. Therm. Anal. Calorimetry 72 (1) (2003) 65–71.

[1258] A.W. Hakin, J.L. Liu, M. O'Shea, B. Zorzetti, Thermodynamics of protein model compounds: apparent molar volumes and isobaric heat capacities of selected cyclic dipeptides and their transfer properties from water to aqueous urea solutions at $T = 298.15$ K, Phys. Chem. Chem. Phys. 5 (12) (2003) 2653–2657.

[1259] P.J. Wan, Z.M. Zarins, Specific heats of cottonseed and its co-products, J. Am. Oil Chem. Soc. 80 (2) (2003) 123–126.

[1260] Y. Fu, I. Wang, J. Liu, Microwave-transmission, heat and temperature properties of electrically conductive adhesive, IEEE Trans. Compon. Packag. Technol. 26 (1) (2003) 193–198.

[1261] S. Graham, D.L. McDowell, Numerical analysis of the transverse thermal conductivity of composites with imperfect interfaces, J. Heat Transfer-Trans. ASME 125 (3) (2003) 389–393.

[1262] T. Tokumasu, T. Ohara, K. Kamijo, Effect of molecular elongation on the thermal conductivity of diatomic liquids, J. Chem. Phys. 118 (8) (2003) 3677–3685.

[1263] X. Yu, D.M. Leitner, Vibrational energy transfer and heat conduction in a protein, J. Phys. Chem. B 107 (7) (2003) 1698–1707.

[1264] Y.K. Tovbin, L.K. Zhidkova, V.N. Komarov, The local heat conductivity coefficients of inert gases and liquids in narrow slitlike pores, Russian J. Phys. Chem. 77 (8) (2003) 1222–1229.

[1265] D.M. Zhang, Y.J. Lei, B.M. Yu, G.J. Pan, The thermal conductivity theory of non-uniform granular flow and the mechanism analysis, Commun. Theor. Phys. 40 (4) (2003) 491–498.

[1266] D. Gerenrot, L. Berlyand, J. Phillips, Random network model for heat transfer in high contrast composite materials, IEEE Trans. Adv. Packag. 26 (4) (2003) 410–416.

[1267] Z. Ignaszak, Substitute thermal conductivity coefficient for multi-component ceramic materials, J. Mater. Process. Technol. 143 (Special Issue SI) (2003) 748–751.

[1268] N. Hamdami, J.Y. Monteau, A. Le Bail, Effective thermal conductivity of a high porosity model food at above and sub-freezing temperatures, Int. J. Refrig.-Rev. Int. Froid 26 (7) (2003) 809–816.

[1269] N. Hamdami, J.Y. Monteau, A. Le Bail, Effective thermal conductivity evolution as a function of temperature and humidity, during freezing of a high-porosity model food, Chem. Eng. Res. Design 81 (A9) (2003) 1123–1128.

[1270] S.S. Sablani, M.S. Rahman, Using neural networks to predict thermal conductivity of food as a function of moisture content, temperature and apparent porosity, Food Res. Int. 36 (6) (2003) 617–623.

[1271] P. Kumar, A.L. Kaleita, Assimilation of near-surface temperature using extended Kalman filter, Adv. Water Res. 26 (1) (2003) 79–93.

[1272] P.L. Woodfield, K. Suzuki, K. Nakabe, Performance of a three-dimensional, pressure-based, unstructured finite-volume method for low-Reynolds-number incompressible flow and wall heat transfer rate prediction, Numer. Heat Transfer B-Fundament. 43 (5) (2003) 403–423.

[1273] C.A. Wick, J.I. Siepmann, M.R. Schure, Temperature dependence of transfer properties: importance of heat capacity effects, J. Phys. Chem. B 107 (38) (2003) 10623–10627.

[1274] I.B. Golovanov, S.M. Zhenodarova, O.A. Smolyaninova, Quantitative structure–property relationship: XIII. Properties of aliphatic alcohols, Russian J. General Chem. 73 (4) (2003) 519–524.

[1275] M.T. Batchelor, X.W. Guan, N. Oelkers, K. Sakai, Z. Tsuboi, A. Foerster, Exact results for the thermal and magnetic properties of strong coupling ladder compounds—art. no. 217202, Phys. Rev. Letters 9121 (21) (2003) 7202.

[1276] X. Lu, J.H. Chu, W.Z. Shen, Modification of the lattice thermal conductivity in semiconductor rectangular nanowires, J. Appl. Phys. 93 (2) (2003) 1219–1229.

[1277] Y.M. Xuan, Q. Li, W.F. Hu, Aggregation structure and thermal conductivity of nanofluids, AIChE J. 49 (4) (2003) 1038–1043.

[1278] J. Avsec, M. Marcic, A. Leipertz, A.P. Froba, Velocity of sound of binary mixture R507 and ternary mixture R404A, J. Thermophys. Heat Transfer 17 (3) (2003) 334–339.

[1279] P.J. Mago, S.A. Sherif, Formulations of thermodynamic properties of supersaturated moist air, Proc. Inst. Mech. Eng. Part C-J. Mech. Eng. Sci. 217 (6) (2003) 705–718.

[1280] G.E. Palmer, M.J. Wright, Comparison of methods to compute high-temperature gas viscosity, J. Thermophys. Heat Transfer 17 (2) (2003) 232–239.

[1281] L.C. Burmeister, Correction for exponential dependence of viscosity on temperature for natural convection by an integral method, J. Heat Transfer-Trans. ASME 125 (4) (2003) 756–760.

[1282] X.J. Zhang, Y.J. Dai, R.Z. Wang, A simulation study of heat and mass transfer in a honeycombed rotary desiccant dehumidifier, Appl. Therm. Eng. 23 (8) (2003) 989–1003.

[1283] L.K. Wang, B. Sunden, Optimal design of plate heat exchangers with and without pressure drop specifications, Appl. Therm. Eng. 23 (3) (2003) 295–311.

[1284] S. Park, D.R. Lee, Investigations of heat transfer and pressure drop between parallel channels with pseudoplastic and dilatant fluids, J. Appl. Polym. Sci. 89 (13) (2003) 3601–3608.

[1285] C.D. Ho, H.M. Yeh, W.Y. Yang, An analytical study of concentric circular heat exchangers with an impermeable sheet inserted for double-pass operations, J. Chin. Inst. Chem. Eng. 34 (4) (2003) 441–445.

[1286] J.R. Thome, On recent advances in modeling of two-phase flow and heat transfer, Heat Transfer Eng. 24 (6) (2003) 46–59.

[1287] J.A.W. Gut, J.M. Pinto, Modeling of plate heat exchangers with generalized configurations, Int. J. Heat Mass Transfer 46 (14) (2003) 2571–2585.

[1288] Y.Y. Jiang, M. Shoji, Spatial and temporal stabilities of flow in a natural circulation loop: influences of thermal boundary condition, J. Heat Transfer-Trans. ASME 125 (4) (2003) 612–623.

[1289] J.U.R. Khan, M. Yaqub, S.M. Zubair, Performance characteristics of counter flow wet cooling towers, Energy Convers. Manage. 44 (13) (2003) 2073–2091.

[1290] J.W. Meewisse, C.A.I. Ferreira, Validation of the use of heat transfer models in liquid/solid fluidized beds for ice slurry generation, Int. J. Heat Mass Transfer 46 (19) (2003) 3683–3695.

[1291] G.F. Nellis, A heat exchanger model that includes axial conduction, parasitic heat loads, and property variations, Cryogenics 43 (9) (2003) 523–538.

[1292] G.F. Nellis, J.R. Maddocks, An isothermal model of a hybrid Stirling/reverse-Brayton cryocooler, Cryogenics 43 (1) (2003) 31–43.

[1293] Z. Radakovic, A. Popovic, Variation of steady-state thermal characteristics of transformers with OFWF cooling in service, Electric Power Compon. Syst. 31 (8) (2003) 817–829.

[1294] Z. Stefanov, K.A. Hoo, A distributed-parameter model of black liquor falling film evaporators. Part I. Modeling of a single plate, Indus. Eng. Chem. Res. 42 (9) (2003) 1925–1937.

[1295] Y.X. Wang, G.P. Peterson, Analytical model for capillary evaporation limitation in thin porous layers, J. Thermophys. Heat Transfer 17 (2) (2003) 145–149.

[1296] P. Haberschill, L. Gay, P. Aubouin, M. Lattemand, Dynamic model of a vapor-compression refrigerating machine using R-407C, Hvac&R Res. 9 (4) (2003) 451–466.

[1297] P.D. Ronney, Analysis of non-adiabatic heat-recirculating combustors, Combust. Flame 135 (4) (2003) 421–439.

[1298] S. Tiwari, G. Biswas, P.L.N. Prasad, S. Basu, Numerical prediction of flow and heat transfer in a rectangular channel with a built-in circular tube, J. Heat Transfer-Trans. ASME 125 (3) (2003) 413–421.

[1299] P. Yuan, Effect of inlet flow maldistribution on the thermal performance of a three-fluid crossflow heat exchanger, Int. J. Heat Mass Transfer 46 (20) (2003) 3777–3787.

[1300] C.D. Ho, W.Y. Yang, An analytical study of heat-transfer efficiency in laminar counterflow concentric circular tubes with external refluxes, Chem. Eng. Sci. 58 (7) (2003) 1235–1250.

[1301] P. Yuan, H.S. Kou, Entropy generation on a crossflow heat exchanger including three gas streams with different arrangements and the effect of longitudinal wall conduction, Numer. Heat Transfer Part A-Appl. 43 (6) (2003) 619–638.

[1302] K. Ogiso, Duality of heat exchanger performance in balanced counter-flow systems, J. Heat Transfer-Trans. ASME 125 (3) (2003) 530–532.

[1303] G.F. Nellis, Effectiveness-NTU relations for heat exchangers with streams having significant kinetic energy variation, J. Heat Transfer-Trans. ASME 125 (2) (2003) 377–387.

[1304] F. Kowsary, M. Biglarbegian, A mathematical confirmation for higher LMTD value of counter flow versus parallel flow heat exchangers, J. Heat Transfer-Trans. ASME 125 (1) (2003) 182–184.

[1305] A. Fakheri, A general expression for the determination of the log mean temperature correction factor for shell and tube heat exchangers, J. Heat Transfer-Trans. ASME 125 (3) (2003) 527–530.

[1306] C.H. Huang, I.C. Yuan, H.C. Ay, A three-dimensional inverse problem in imaging the local heat transfer coefficients for plate finned-tube heat exchangers, Int. J. Heat Mass Transfer 46 (19) (2003) 3629–3638.

[1307] F. Contarin, A.V. Saveliev, A.A. Fridman, L.A. Kennedy, A reciprocal flow filtration combustor with embedded heat exchangers: numerical study, Int. J. Heat Mass Transfer 46 (6) (2003) 949–961.

[1308] T. Kyono, R.O. Suzuki, K. Ono, Conversion of unused heat energy to electricity by means of thermoelectric generation in condenser, IEEE Trans. Energy Convers. 18 (2) (2003) 330–334.

[1309] I. Balen, P. Donjerkovic, I. Galaso, Analysis of the coil energy recovery loop system, Int. J. Energy Res. 27 (4) (2003) 363–376.

[1310] J. Lee, Y.C. Kwon, M.H. Kim, An improved method for analyzing a fin and tube evaporator containing a zeotropic mixture refrigerant with air mal-distribution, Int. J. Refrig.-Rev. Int. Froid 26 (6) (2003) 707–720.

[1311] G.A. Florides, S.A. Kalogirou, S.A. Tassou, L.C. Wrobel, Design and construction of a LiBr–water absorption machine, Energy Convers. Manage. 44 (15) (2003) 2483–2508.

[1312] P.K. Sahoo, M.I.A. Ansari, A.K. Datta, A computer based iterative solution for accurate estimation of heat transfer coefficients in a helical tube heat exchanger, J. Food Eng. 58 (3) (2003) 211–214.

[1313] H.M. Yeh, M.J. Hsieh, Analysis of membrane dialysis through rectangular mass exchangers, J. Chin. Inst. Chem. Eng. 34 (3) (2003) 381–386.

[1314] T.B. Styrylska, A.A. Lechowska, Unified Wilson plot method for determining heat transfer correlations for heat exchangers, J. Heat Transfer-Trans. ASME 125 (4) (2003) 752–756.

[1315] R. Boehme, J.A.R. Parise, R.P. Marques, Simulation of multistream plate-fin heat exchangers of an air separation unit, Cryogenics 43 (6) (2003) 325–334.

[1316] J. Yin, M.K. Jensen, Analytic model for transient heat exchanger response, Int. J. Heat Mass Transfer 46 (17) (2003) 3255–3264.

[1317] A.I. Elsherbini, A.M. Jacobi, P.S. Hrnjak, Experimental investigation of thermal contact resistance in plain-fin-and-tube evaporators with collarless fins, Int. J. Refrig.-Rev. Int. Froid 26 (5) (2003) 527–536.

[1318] D.H. Han, K.J. Lee, Y.H. Kim, Experiments on the characteristics of evaporation of R410A in brazed plate heat exchangers with different geometric configurations, Appl. Therm. Eng. 23 (10) (2003) 1209–1225.

[1319] C.N. Kim, J. Jeong, B. Youn, Evaluation of thermal contact conductance using a new experimental–numerical method in fin-tube heat exchangers, Int. J. Refrig.-Rev. Int. Froid 26 (8) (2003) 900–908.

[1320] C.N. Kim, J. Jeong, B. Youn, S.H. Kil, An experimental–numerical evaluation of thermal contact conductance in fin-tube heat exchangers, JSME Int. J. Ser. B-Fluids Therm. Eng. 46 (2) (2003) 299–307.

[1321] H.C. Lee, G. Kang, Y.P. Lee, H.S. Han, D.K. Stevens, Development of an advanced evaporation system with fouling-free technology using a circulating fluidized bed heat exchanger, Environmental Eng. Science 20 (4) (2003) 319–327.

[1322] J. Mabit, F. Fayolle, J. Legrand, Shear rates investigation in a scraped surface heat exchanger, Chem. Eng. Sci. 58 (20) (2003) 4667–4679.

[1323] N.K. Maheshwari, D. Saha, R.K. Sinha, M. Aritomi, Experimental studies on condensation of steam mixed with noncondensable gas inside the vertical tube in a pool filled with subcooled water, Kerntechnik 68 (5–6) (2003) 235–244.

[1324] A. Pacheco-Vega, M. Sen, K.T. Yang, Simultaneous determination of in- and over-tube heat transfer correlations in heat exchangers by global regression, Int. J. Heat Mass Transfer 46 (6) (2003) 1029–1040.

[1325] R.A. Wirtz, J. Xu, J.W. Park, D. Ruch, Thermal/fluid characteristics of 3-D woven mesh structures as heat exchanger surfaces, IEEE Trans. Compon. Packag. Technol. 26 (1) (2003) 40–47.

[1326] J. Gylys, M. Jakubcionis, S. Sinkunas, Heat transfer during foam flow across bank of tubes, Heat Transfer Eng. 24 (5) (2003) 17–24.

[1327] B. Sirok, B. Blagojevic, M. Novak, M. Hocevar, F. Jere, Energy and mass transfer phenomena in natural draft cooling towers, Heat Transfer Eng. 24 (3) (2003) 66–75.

[1328] M. Valles, M. Bourouis, D. Boer, A. Coronas, Absorption of organic fluid mixtures in plate heat exchangers, Int. J. Therm. Sci. 42 (1) (2003) 85–94.

[1329] Y.Y. Hsieh, T.F. Lin, Evaporation heat transfer and pressure drop of refrigerant R-410A flow in a vertical plate heat exchanger, J. Heat Transfer-Trans. ASME 125 (5) (2003) 852–857.

[1330] O. Garcia-Valladares, J.C. Gonzalez, J.I. Hernandez, R.B.Y. Brown, The evaluation of a small capacity shell and tube ammonia evaporator, Appl. Therm. Eng. 23 (17) (2003) 2151–2167.

[1331] P.K. Bansal, B. Xu, A parametric study of refrigerant flow in non-adiabatic capillary tubes, Appl. Therm. Eng. 23 (4) (2003) 397–408.

[1332] P.K. Bansal, T.C. Chin, Modelling and optimisation of wire-and-tube condenser, Int. J. Refrig.-Rev. Int. Froid 26 (5) (2003) 601–613.

[1333] P.K. Bansal, T. Chin, Heat transfer characteristics of wire-and-tube and hot-wall condensers, Hvac&R Res. 9 (3) (2003) 277–290.

[1334] K.C.A. Alam, Y.T. Kang, B.B. Saha, A. Akisawa, T. Kashiwagi, A novel approach to determine optimum switching frequency of a conventional adsorption chiller, Energy 28 (10) (2003) 1021–1037.

[1335] Z.H. Ayub, Plate heat exchanger literature survey and new heat transfer and pressure drop correlations for refrigerant evaporators, Heat Transfer Eng. 24 (5) (2003) 3–16.

[1336] R.K. Jassim, Evaluation of combined heat and mass transfer effect on the thermoeconomic optimization of an air-conditioning rotary regenerator, J. Heat Transfer-Trans. ASME 125 (4) (2003) 724–733.

[1337] O. Lottin, P. Guillemet, J.M. Lebreton, Effects of synthetic oil in a compression refrigeration system using R410A. Part II: Quality of heat transfer and pressure losses within the heat exchangers, Int. J. Refrig.-Rev. Int. Froid 26 (7) (2003) 783–794.

[1338] G.Q. Lu, P. Cheng, Numerical and experimental study of a Gifford-McMahon-type pulse tube refrigerator, J. Thermophys. Heat Transfer 17 (4) (2003) 457–463.

[1339] M.M. Prieto, I.M. Suarez, E. Montanes, Analysis of the thermal performance of a church window steam condenser for different operational conditions using three models, Appl. Therm. Eng. 23 (2) (2003) 163–178.

[1340] B.B. Saha, S. Koyama, J.B. Lee, K. Kuwahara, K.C.A. Alam, Y. Hamamoto, A. Akisawa, T. Kashiwagi, Performance evaluation of a low-temperature waste heat driven multi-bed adsorption chiller, Int. J. Multiphase Flow 29 (8) (2003) 1249–1263.

[1341] D.W. Johnson, C. Yavuzturk, J. Pruis, Analysis of heat and mass transfer phenomena in hollow fiber membranes used for evaporative cooling, J. Membrane Science 227 (1–2) (2003) 159–171.

[1342] S.B. Zhou, L.G. Chen, F.R. Sun, C. Wu, Theoretical optimization of a regenerated air refrigerator, J. Physics D-Applied Physics 36 (18) (2003) 2304–2311.

[1343] K.X. Tan, S.M. Deng, A numerical analysis of heat and mass transfer inside a reversibly used water cooling tower, Build. Environ. 38 (1) (2003) 91–97.

[1344] C. Zamfirescu, A. Bejan, Constructal tree-shaped two-phase flow for cooling a surface, Int. J. Heat Mass Transfer 46 (15) (2003) 2785–2797.

[1345] M. Ravagnani, A.P. da Silva, A.L. Andrade, Detailed equipment design in heat exchanger networks synthesis and optimisation, Appl. Therm. Eng. 23 (2) (2003) 141–151.

[1346] X. Luo, X. Guan, M. Li, W. Roetzel, Dynamic behaviour of one-dimensional flow multistream heat exchangers and their networks, Int. J. Heat Mass Transfer 46 (4) (2003) 705–715.

[1347] Y. Islamoglu, A new approach for the prediction of the heat transfer rate of the wire-on-tube type heat exchanger—use of an artificial neural network model, Appl. Therm. Eng. 23 (2) (2003) 243–249.

[1348] S. Fiedler, S. Yildiz, H. Auracher, Determination of film thickness and flooding during reflux condensation in a small, inclined tube with an ultrasonic transducer, Int. J. Energy Res. 27 (4) (2003) 315–325.

[1349] C.F. McDonald, Recuperator considerations for future higher efficiency microturbines, Appl. Therm. Eng. 23 (12) (2003) 1463–1487.

[1350] J.A. Mathias, J. Cao, M.E. Ewing, R.N. Christensen, Experimental characterization of compact heat exchangers with short flow lengths at simulated elevated altitudes, J. Fluids Eng.-Trans. ASME 125 (1) (2003) 171–180.

[1351] M.G. Sutton, D.W. Nutter, R.J. Couvillion, A ground resistance for vertical bore heat exchangers with groundwater flow, J. Energy Resources Technology-Trans. ASME the ASME 125 (3) (2003) 183–189.

[1352] M. De Paepe, A. Janssens, Thermo-hydraulic design of earth-air heat exchangers, Energy and Buildings 35 (4) (2003) 389–397.

[1353] P. Hollmuller, Analytical characterisation of amplitude-dampening and phase-shifting in air/soil heat-exchangers, Int. J. Heat Mass Transfer 46 (22) (2003) 4303–4317.

[1354] H.Y. Zeng, N.R. Diao, Z.H. Fang, Heat transfer analysis of boreholes in vertical ground heat exchangers, Int. J. Heat Mass Transfer 46 (23) (2003) 4467–4481.

[1355] W.X. Jin, S.C. Low, T. Quek, Preliminary experimental study of falling film heat transfer on a vertical doubly fluted plate, Desalination 152 (1–3) (2003) 201–206.

[1356] K. Boomsma, D. Poulikakos, F. Zwick, Metal foams as compact high performance heat exchangers, Mechanics of Materials 35 (12) (2003) 1161–1176.

[1357] S. Hardt, W. Ehrfeld, V. Hessel, K.M. Vanden Bussche, Strategies for size reduction of microreactors by heat transfer enhancement effects, Chemical Eng. Communications 190 (4) (2003) 540–559.

[1358] P.Y. Chang, M.N. Fu, C.H. Chen, Simulation for velocity measurement with thermal micro-flow sensors, Jpn. J. Appl. Phys. Part 1-Regular Papers Short Notes & Review Papers 42 (9A) (2003) 5859–5864.

[1359] S. Belhardj, S. Mimouni, A. Saidane, A. Benzohra, Using microchannels to cool microprocessors: a transmission-line-matrix study, Microelectronics Journal 34 (4) (2003) 247–253.

[1360] C.D. Ho, W.Y. Yang, The influences of recycle on a double-pass laminar counterflow concentric circular heat exchangers, Int. J. Heat Mass Transfer 46 (12) (2003) 2103–2113.

[1361] A. Jain, G. Biswas, D. Maurya, Winglet-type vortex generators with common-flow-up configuration for fin-tube heat exchangers, Numer. Heat Transfer Part A-Appl. 43 (2) (2003) 201–219.

[1362] E. Konstantinidis, S. Balabani, M. Yianneskis, Relationship between vortex shedding lock-on and heat transfer—implications for tube bundles in cross-flow, Chem. Eng. Res. Design 81 (A6) (2003) 695–699.

[1363] K. Krishnakumar, G. Venkatarathnam, Transient testing of perforated plate matrix heat exchangers, Cryogenics 43 (2) (2003) 101–109.

[1364] P.M. Park, H.C. Cho, H.D. Shin, Unsteady thermal flow analysis in a heat regenerator with spherical particles, Int. J. Energy Res. 27 (2) (2003) 161–172.

[1365] P.G. Rousseau, M. van Eldik, G.P. Greyvenstein, Detailed simulation of fluted tube water heating condensers, Int. J. Refrig.-Rev. Int. Froid 26 (2) (2003) 232–239.

[1366] B.A.K. Abu-Hijleh, Numerical simulation of forced convection heat transfer from a cylinder with high conductivity radial fins in cross-flow, Int. J. Therm. Sci. 42 (8) (2003) 741–748.

[1367] S. Waszkiewicz, S. Jenkins, H. Saidani-Scott, M. Tierney, Analysis of a finned heat exchanger working in an adsorption refrigeration system using zeolite and methanol, Heat Transfer Eng. 24 (6) (2003) 71–78.

[1368] J.D. Chung, B.K. Park, J.S. Lee, The combined effects of angle of attack and louver angle of a winglet pair on heat transfer enhancement, J. Enhanced Heat Transfer 10 (1) (2003) 31–43.

[1369] Y.L. Tsay, J.C. Cheng, T.S. Chang, Enhancement of heat transfer from surface-mounted block heat sources in a duct with baffles, Numer. Heat Transfer Part A-Appl. 43 (8) (2003) 827–841.

[1370] A.K. Saha, S. Acharya, Parametric study of unsteady flow and heat transfer in a pin-fin heat exchanger, Int. J. Heat Mass Transfer 46 (20) (2003) 3815–3830.

[1371] C.H. Song, D.Y. Lee, S.T. Ro, Cooling enhancement in an air-cooled finned heat exchanger by thin water film evaporation, Int. J. Heat Mass Transfer 46 (7) (2003) 1241–1249.

[1372] P. Razelos, R.N. Krikkis, The optimum design of radiating and convective-radiating circular fins, Heat Transfer Eng. 24 (3) (2003) 17–41.

[1373] D.K. Tafti, J. Cui, Fin-tube junction effects on flow and heat transfer in flat tube multilouvered heat exchangers, Int. J. Heat Mass Transfer 46 (11) (2003) 2027–2038.

[1374] S. Tiwari, D. Maurya, G. Biswas, V. Eswaran, Heat transfer enhancement in cross-flow heat exchangers using oval tubes and multiple delta winglets, Int. J. Heat Mass Transfer 46 (15) (2003) 2841–2856.

[1375] H. Coetzee, L. Liebenberg, J.P. Meyer, Heat transfer and pressure drop characteristics of angled spiraling tape inserts in a heat exchanger annulus, Heat Transfer Eng. 24 (6) (2003) 29–39.

[1376] N.C. DeJong, A.M. Jacobi, Flow, heat transfer, and pressure drop in the near-wall region of louvered-fin arrays, Exp. Therm. Fluid Sci. 27 (3) (2003) 237–250.

[1377] L. Fang, J. Abraham, V.W. Goldschmidt, Thermal and hydraulic effects of dimples on performance of clamshell heat exchangers in residential gas furnaces, Hvac&R Res. 9 (1) (2003) 79–94.

[1378] D.H. Han, K.J. Lee, Y.H. Kim, The characteristics of condensation in brazed plate heat exchangers with different chevron angles, J. the Korean Physical Society 43 (1) (2003) 66–73.

[1379] A. Hasan, K. Siren, Performance investigation of plain and finned tube evaporatively cooled heat exchangers, Appl. Therm. Eng. 23 (3) (2003) 325–340.

[1380] Y. Islamoglu, C. Parmaksizoglu, The effect of channel height on the enhanced heat transfer characteristics in a corrugated heat exchanger channel, Appl. Therm. Eng. 23 (8) (2003) 979–987.

[1381] Y.S. Lee, C.C. Su, Y.M. Sun, J.C. Ye, Experimental study on heat transfer in wavy channels, J. Enhanced Heat Transfer 10 (1) (2003) 21–29.

[1382] A.A. Mohamad, Heat transfer enhancements in heat exchangers fitted with porous media Part I: constant wall temperature, Int. J. Therm. Sci. 42 (4) (2003) 385–395.

[1383] K.A. Moores, Y.K. Joshi, Effect of tip clearance on the thermal and hydrodynamic performance of a shrouded pin fin array, J. Heat Transfer-Trans. ASME 125 (6) (2003) 999–1006.

[1384] V.G. Pastukhov, Y.F. Maidanik, C.V. Vershinin, M.A. Korukov, Miniature loop heat pipes for electronics cooling, Appl. Therm. Eng. 23 (9) (2003) 1125–1135.

[1385] F.G.F. Qin, X.D. Chen, A.B. Russell, Heat transfer at the subcooled-scraped surface with/without phase change, AIChE J. 49 (8) (2003) 1947–1955.

[1386] O.N. Sara, Performance analysis of rectangular ducts with staggered square pin fins, Energy Convers. Manage. 44 (11) (2003) 1787–1803.

[1387] K.M. Kwak, K. Torii, K. Nishino, Heat transfer and pressure loss penalty for the number of tube rows of staggered finned-tube bundles with a single transverse row of winglets, Int. J. Heat Mass Transfer 46 (1) (2003) 175–180.

[1388] R. Krupiczka, A. Rotkegel, H. Walczyk, On the airside heat transfer performance of finned tube bundles, Inz. Chem. Procesowa 24 (1) (2003) 21–32.

[1389] Y.Y. Qi, Y. Kawaguchi, R.N. Christensen, J.L. Zakin, Enhancing heat transfer ability of drag reducing surfactant solutions with static mixers and honeycombs, Int. J. Heat Mass Transfer 46 (26) (2003) 5161–5173.

[1390] K.H. Ko, N.K. Anand, Use of porous baffles to enhance heat transfer in a rectangular channel, Int. J. Heat Mass Transfer 46 (22) (2003) 4191–4199.

[1391] J.S. Go, Design of a microfin array heat sink using flow-induced vibration to enhance the heat transfer in the laminar flow regime, Sens. Actuat. A-Phys. 105 (2) (2003) 201–210.

[1392] N. Souidi, A. Bontemps, Reflux condensation in narrow rectangular channels with perforated fins, Appl. Therm. Eng. 23 (7) (2003) 871–891.

[1393] W.M. Yan, H.Y. Li, Y.J. Wu, J.Y. Lin, W.R. Chang, Performance of finned tube heat exchangers operating under frosting conditions, Int. J. Heat Mass Transfer 46 (5) (2003) 871–877.

[1394] R. Yang, X.B. Hu, Y.P. Zhang, Preparation, physical property and thermal physical property of phase change microcapsule slurry and phase change emulsion, Solar Energy Mater. Solar Cells 80 (4) (2003) 405–416.

[1395] B. Youn, Y.S. Kim, H.Y. Park, N.H. Kim, An experimental investigation on the airside performance of fin-and-tube heat exchangers having radial silt fins, J. Enhanced Heat Transfer 10 (1) (2003) 61–80.

[1396] J.Y. Kim, T.H. Song, Effect of tube alignment on the heat/mass transfer from a plate fin and two-tube assembly: naphthalene sublimation results, Int. J. Heat Mass Transfer 46 (16) (2003) 3051–3059.

[1397] S.D. Gao, L.B. Wang, Y.H. Zhang, F. Ke, The optimum height of winglet vortex generators mounted on three-row flat tube bank fin, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1007–1016.

[1398] M.L. Smotrys, H. Ge, A.M. Jacobi, J.C. Dutton, Flow and heat transfer behavior for a vortex-enhanced interrupted fin, J. Heat Transfer-Trans. ASME 125 (5) (2003) 788–794.

[1399] B. Bansal, X.D. Chen, H. Muller-Steinhagen, Analysis of deposits to study the effect of particles on crystallisation fouling, J. Chin. Inst. Chem. Eng. 34 (3) (2003) 299–303.

[1400] M. Bohnet, Influence of the transport properties of the crystal/heat transfer surface interfacial on fouling behavior, Chem. Eng. Technol. 26 (10) (2003) 1055–1060.

[1401] F. Brahim, W. Augustin, M. Bohnet, Numerical simulation of the fouling process, Int. J. Therm. Sci. 42 (3) (2003) 323–334.

[1402] H. Glade, J. Ulrich, Influence of solution composition on the formation of crystalline scales, Chem. Eng. Technol. 26 (3) (2003) 277–281.

[1403] A.M. Iglesias, M.A.D. Calderon, Thermal resistance contributions of oxides growth on Incoloy 800 steam generator tubes, Nucl. Eng. Design 219 (1) (2003) 1–10.

[1404] W. Li, The internal surface area basis, a key issue of modeling fouling in enhanced heat transfer tubes, Int. J. Heat Mass Transfer 46 (22) (2003) 4345–4349.

[1405] J.A. Siegel, W.W. Nazaroff, Predicting particle deposition on HVAC heat exchangers, Atmospheric Environment 37 (39–40) (2003) 5587–5596.

[1406] N. Andritsos, A.J. Karabelas, Calcium carbonate scaling in a plate heat exchanger in the presence of particles, Int. J. Heat Mass Transfer 46 (24) (2003) 4613–4627.

[1407] M.S. Kim, B.J. Baek, T. Ota, Fouling effect of water scale on heat transfer around a tube in staggered tube banks, Int. J. Energy Res. 27 (4) (2003) 337–348.

[1408] O. Korkut, H. Sarac, B. Atabek, O. Lacin, Investigation of changes in fouling (occurred during milk pasteurization) resistance by alkaline-acidic cleaning solutions, Milchwissenschaft-Milk Science International 58 (7–8) (2003) 409–412.

[1409] R. Lankinen, J. Suihkonen, P. Sarkomaa, The effect of air side fouling on thermal-hydraulic characteristics of a compact heat exchanger, Int. J. Energy Res. 27 (4) (2003) 349–361.

[1410] W. Li, The performances of internal helical-rib roughness tubes under fouling conditions: Practical cooling tower water fouling and accelerated particulate fouling, J. Heat Transfer-Trans. ASME 125 (4) (2003) 746–748.

[1411] K.P.H. Meesters, J.W. Van Groenestijn, J. Gerritse, Biofouling reduction in recirculating cooling systems through biofiltration of process water, Water Research 37 (3) (2003) 525–532.

[1412] A. Ots, T. Tiikma, On the fouling mechanism of non-bounded oil shale ash deposits on boiler heat-transfer surfaces, Oil Shale 20 (1) (2003) 3–13.

[1413] B.C. Pak, B.J. Baek, E.A. Groll, Impacts of fouling and cleaning on the performance of plate fin and spine fin heat exchangers, KSME Int. J. 17 (11) (2003) 1801–1811.

[1414] M. Rahimi, I. Owen, J. Mistry, Thermal stresses in boiler tubes arising from high-speed cleaning jets, Int. J. Mechanical Sciences 45 (6–7) (2003) 995–1009.

[1415] B. Shi, W.J. Frederick, R.W. Rousseau, Nucleation, growth and composition of crystals obtained from solutions of Na_2CO_3 and Na_2SO_4, Indus. Eng. Chem. Res. 42 (25) (2003) 6343–6347.

[1416] S. Su, J.H. Pohl, D. Holcombe, Fouling propensities of blended coals in pulverized coal-fired power station boilers, Fuel 82 (13) (2003) 1653–1667.

[1417] B.Y. Wu, S.H. Chan, Mitigation of particulate fouling by ozonation, J. Heat Transfer-Trans. ASME 125 (1) (2003) 147–150.

[1418] Y.W. Zhang, A. Faghri, Oscillatory flow in pulsating heat pipes with arbitrary numbers of turns, J. Thermophys. Heat Transfer 17 (3) (2003) 340–347.

[1419] C.K. Teoh, A.R. Maschmann, H.B. Ma, Heat-transfer analysis in heat sink embedded with a thermosyphon, J. Thermophys. Heat Transfer 17 (3) (2003) 348–353.

[1420] F. Song, D. Ewing, C.Y. Ching, Fluid flow and heat transfer model for high-speed rotating heat pipes, Int. J. Heat Mass Transfer 46 (23) (2003) 4393–4401.

[1421] A. Simakin, A. Ghassemi, Salt loaded heat pipes: steady-state operation and related heat and mass transport, Earth Planet. Sci. Lett. 215 (3–4) (2003) 411–424.

[1422] M.A. Hanlon, H.B. Ma, Evaporation heat transfer in sintered porous media, J. Heat Transfer-Trans. ASME 125 (4) (2003) 644–652.

[1423] M. Maiani, W.J.M. de Kruijf, W. Ambrosini, An analytical model for the determination of stability boundaries in a natural circulation single-phase thermosyphon loop, Int. J. Heat Fluid Flow 24 (6) (2003) 853–863.

[1424] H.A. Machado, R.F. de Miranda, Operation limits for rotating cylindrical heat pipes, Numer. Heat Transfer Part A-Appl. 44 (3) (2003) 299–313.

[1425] J.M. Tournier, M.S. El-Genk, Startup of a horizontal lithium–molybdenum heat pipe from a frozen state, Int. J. Heat Mass Transfer 46 (4) (2003) 671–685.

[1426] S. Wangnipparnto, J. Tiansuwan, T. Kiatsiriroat, C.C. Wang, Performance analysis of thermosyphon heat exchanger under electric field, Energy Convers. Manage. 44 (7) (2003) 1163–1175.

[1427] B. Palm, R. Khodabandeh, Choosing working fluid for two-phase thermosyphon systems for cooling of electronics, J. Electron. Packag. 125 (2) (2003) 276–281.

[1428] L. Yuan, Y.K. Joshi, W. Nakayama, Effect of condenser location and imposed circulation on the performance of a compact two-phase thermosyphon, Microscale Thermophys. Eng. 7 (2) (2003) 163–179.

[1429] C. Gillot, Y. Avenas, N. Cezac, G. Poupon, C. Schaeffer, E. Fournier, Silicon heat pipes used as thermal spreaders, IEEE Trans. Compon. Packag. Technol. 26 (2) (2003) 332–339.

[1430] S.J. Kim, J.K. Seo, K.H. Do, Analytical and experimental investigation on the operational characteristics and the thermal optimization of a miniature heat pipe with a grooved wick structure, Int. J. Heat Mass Transfer 46 (11) (2003) 2051–2063.

[1431] Z.Q. Yu, K.P. Hallinan, R.A. Kashani, Temperature control of electrohydrodynamic micro heat pipes, Exp. Therm. Fluid Sci. 27 (8) (2003) 867–875.

[1432] D.J. Stevenson, Styles of mantle convection and their influence on planetary evolution, Comptes Rendus Geoscience 335 (1) (2003) 99–111.

[1433] H. Zhang, J. Zhuang, Research, development and industrial application of heat pipe technology in China, Appl. Therm. Eng. 23 (9) (2003) 1067–1083.

[1434] M. Gao, Y. Cao, Flat and U-shaped heat spreaders for high-power electronics, Heat Transfer Eng. 24 (3) (2003) 57–65.

[1435] M. Cerza, B. Boughey, The effects of air infiltration on a large flat heat pipe at horizontal and vertical orientations, J. Heat Transfer-Trans. ASME 125 (2) (2003) 349–355.

[1436] K.I. Han, D.H. Cho, J.U. Park, Investigation of boiling heat transfer characteristics of two-phase closed thermosyphons with various internal grooves, KSME Int. J. 17 (11) (2003) 1739–1745.

[1437] P. Charoensawan, S. Khandekar, M. Groll, P. Terdtoon, Closed loop pulsating heat pipes—Part A: Parametric experimental investigations, Appl. Therm. Eng. 23 (16) (2003) 2009–2020.

[1438] S. Rittidech, P. Terdtoon, M. Murakami, P. Kamonpet, W. Jompakdee, Correlation to predict heat transfer characteristics of a closed-end oscillating heat pipe at normal operating condition, Appl. Therm. Eng. 23 (4) (2003) 497–510.

[1439] J.S. Kim, N.H. Bui, H.S. Jung, W.H. Lee, The study on pressure oscillation and heat transfer characteristics of oscillating capillary tube heat pipe, KSME Int. J. 17 (10) (2003) 1533–1542.

[1440] J.S. Kim, N.H. Bui, J.W. Kim, J.H. Kim, H.S. Jung, Flow visualization of oscillation characteristics of liquid and vapor flow in the oscillating capillary tube heat pipe, KSME Int. J. 17 (10) (2003) 1507–1519.

[1441] S.W. Chang, L.M. Su, W.D. Morris, T.M. Liou, Heat transfer in a smooth-walled reciprocating anti-gravity open thermosyphon, Int. J. Therm. Sci. 42 (12) (2003) 1089–1103.

[1442] D.H. Cho, K.I. Han, Influence of the inclination angle and liquid charge ratio on the condensation in closed two-phase thermosyphons with axial internal low-fins, KSME Int. J. 17 (3) (2003) 422–428.

[1443] N. Waowaew, P. Terdtoon, S. Maezawa, P. Kamonpet, W. Klongpanich, Correlation to predict heat transfer characteristics of a radially rotating heat pipe at vertical position, Appl. Therm. Eng. 23 (8) (2003) 1019–1032.

[1444] H. Farsi, J.L. Joly, M. Miscevic, V. Platel, N. Mazet, An experimental and theoretical investigation of the transient behavior of a two-phase closed thermosyphon, Appl. Therm. Eng. 23 (15) (2003) 1895–1912.

[1445] R.R. Williams, D.K. Harris, Cross-plane and in-plane porous properties measurements of thin metal felts: applications in heat pipes, Exp. Therm. Fluid Sci. 27 (3) (2003) 227–235.

[1446] J.S. Lee, S.H. Rhi, C.N. Kim, Y. Lee, Use of two-phase loop thermosyphons for thermoelectric refrigeration: experiment and analysis, Appl. Therm. Eng. 23 (9) (2003) 1167–1176.

[1447] P. Marcarino, A. Merlone, Gas-controlled heat-pipes for accurate temperature measurements, Appl. Therm. Eng. 23 (9) (2003) 1145–1152.

[1448] T. Kaya, J.T. Ku, Thermal operational characteristics of a small-loop heat pipe, J. Thermophys. Heat Transfer 17 (4) (2003) 464–470.

[1449] M. Le Berre, S. Launay, V. Sartre, M. Lallemand, Fabrication and experimental investigation of silicon micro heat pipes for cooling electronics, J. Micromech. Microeng. 13 (3) (2003) 436–441.

[1450] Y. Okano, T. Kohriyama, Y. Yoshida, M. Murase, Modeling of debris cooling with annular gap in the lower RPV and verification based on ALPHA experiments, Nucl. Eng. Design 223 (2) (2003) 145–158.

[1451] F. Martin-Fuertes, J.M. Martin-Valdepenas, J. Mira, M.J. Sanchez, A melcor application to two light water reactor nuclear power plant core melt scenarios with assumed cavity flooding action, Nucl. Technol. 144 (1) (2003) 34–48.

[1452] Y. Maruyama, K. Moriyama, H. Nakamura, M. Hirano, K. Nakajima, Modeling for evaluation of debris coolability in lower plenum of reactor pressure vessel, J. Nucl. Sci. Technol. 40 (1) (2003) 12–21.

[1453] V. Tang, R.R. Parker, Temperature transients of a fusion-fission ITER pebble bed reactor in loss of coolant accident, Fusion Eng. Design 65 (1) (2003) 11–26.

[1454] K.H. Han, S.H. Chang, Development of a thermal-hydraulic analysis code for annular fuel assemblies, Nucl. Eng. Design 226 (3) (2003) 267–275.

[1455] C.E. Peterson, J.G. Shatford, J.F. Harrison, L.J. Agee, Evaluation of the RETRAN-3D wall friction models and heat transfer coefficient correlations, Nucl. Technol. 142 (1) (2003) 64–76.

[1456] A.S. Usmani, Y.C. Chung, J.L. Torero, How did the WTC towers collapse: a new theory, Fire Safety Journal 38 (6) (2003) 501–533.

[1457] N. Ludwig, Thermographic testing on buildings using a simplified heat transfer model, Materials Evaluation 61 (5) (2003) 599–603.

[1458] B. Lacarriere, B. Lartigue, F. Monchoux, Numerical study of heat transfer in a wall of vertically perforated bricks: influence of assembly method, Energy and Buildings 35 (3) (2003) 229–237.

[1459] A.C. Garrabrants, D.S. Kosson, Modeling moisture transport from a Portland cement-based material during storage in reactive and inert atmospheres, Drying Technology 21 (5) (2003) 775–805.

[1460] D.J. Goering, Passively cooled railway embankments for use in permafrost areas, J. Cold Regions Eng. 17 (3) (2003) 119–133.

[1461] Y.M. Lai, J.J. Li, F.J. Niu, W.B. Yu, Nonlinear thermal analysis for Qing-Tibet railway embankments in cold regions, J. Cold Regions Eng. 17 (4) (2003) 171–184.

[1462] A. Hagishima, J. Tanimoto, Field measurements for estimating the convective heat transfer coefficient at building surfaces, Build. Environ. 38 (7) (2003) 873–881.

[1463] A. Trombe, A. Suleiman, Y. Le Maoult, Use of an inverse method to determine natural convection heat transfer coefficients in unsteady state, J. Heat Transfer-Trans. ASME 125 (6) (2003) 1017–1026.

[1464] C.B. Zhao, G. Lin, B.E. Hobbs, A. Ord, Y.J. Wang, H.B. Muhlhaus, Effects of hot intrusions on pore-fluid flow and heat transfer in fluid-saturated rocks, Comput. Methods Appl. Mech. Eng. 192 (16–18) (2003) 2007–2030.

[1465] E. Santoyo, A. Garcia, G. Espinosa, S. Santoyo-Gutierrez, E. Gonzalez-Partida, Convective heat-transfer coefficients of non-Newtonian geothermal drilling fluids, J. Geochem. Explorat. 78-9 (Special Issue SI) (2003) 249–255.

[1466] J. Inoue, J. Ono, Y. Tachibana, M. Honda, K. Iwamoto, Y. Fujiyoshi, K. Takeuchi, Characteristics of heat transfer over the ice covered Sea of Okhotsk during cold-air outbreaks, J. Meteorol. Soc. Jpn. 81 (5) (2003) 1057–1067.

[1467] K.M. Golden, Critical behavior of transport in sea ice, Physica B: Condensed Matter 338 (1–4) (2003) 274–283.

[1468] G. Buttner, E. Huenges, The heat transfer in the region of the Mauna Kea (Hawaii)—constraints from borehole temperature measurements and coupled thermo-hydraulic modeling, Tectonophysics 371 (1–4) (2003) 23–40.

[1469] J.H. Ryu, D.H. Choi, S.J. Kim, Three-dimensional numerical optimization of a manifold microchannel heat sink, Int. J. Heat Mass Transfer 46 (9) (2003) 1553–1562.

[1470] C.H. Cheng, H.H. Lin, W. Aung, Optimal shape design for packaging containing heating elements by inverse heat transfer method, Heat Mass Transfer 39 (8–9) (2003) 687–692.

[1471] J. Darabi, K. Ekula, Development of a chip-integrated micro cooling device, Microelectron. J. 34 (11) (2003) 1067–1074.

[1472] K.A. Brucker, J. Majdalani, Equivalent thermal conductivity for compact heat sink models based on the Churchill and Chu correlation, IEEE Trans. Compon. Packag. Technol. 26 (1) (2003) 158–164.

[1473] L. Ghodoossi, N. Egrican, Exact solution for cooling of electronics using constructal theory, J. Appl. Phys. 93 (8) (2003) 4922–4929.

[1474] M. Sweetland, J.H. Lienhard, Active thermal control of distributed parameter systems with application to testing of packaged IC devices, J. Heat Transfer-Trans. ASME 125 (1) (2003) 164–174.

[1475] S.Y. Yoo, J.H. Park, M.H. Chung, Local heat transfer characteristics in simulated electronic modules, J. Electron. Packag. 125 (3) (2003) 362–368.

[1476] C.B. Coetzer, J.A. Visser, Compact modeling of forced flow in longitudinal fin heat sinks with tip bypass, J. Electron. Packag. 125 (3) (2003) 319–324.

[1477] M. Cheng, F.H. Sun, H.L. Wang, R.W. Yuan, Z.H. Qu, S.Q. Zhang, Experimental research on the dynamic characteristics of the cutting temperature in the process of high-speed milling, J. Mater. Process. Technol. 138 (Special Issue SI) (2003) 468–471.

[1478] S.K. Kim, H.J. Kim, W.I. Lee, Characterization of boundary conditions during thermoplastic composite tape lay-up process using an inverse method, Modell. Simulat. Mater. Sci. Eng. 11 (4) (2003) 417–426.

[1479] J. Kim, T.J. Moon, J.R. Howell, Transient thermal modeling of in-situ curing during tape winding of composite cylinders, J. Heat Transfer-Trans. ASME 125 (1) (2003) 137–146.

[1480] A. Shojaei, S.R. Ghaffarian, S.M.H. Karimian, Simulation of the three-dimensional non-isothermal mold filling process in resin transfer molding, Compos. Sci. Technol. 63 (13) (2003) 1931–1948.

[1481] D. Hohne, B. Pitschel, M. Merkwitz, R. Lobig, Measurement and mathematical modelling of the heat transfer in the glass forming process, in consideration of the heat transfer coefficients and radiation influences, Glastech. Ber.-Glass Science Technol. 76 (6) (2003) 309–317.

[1482] M.A. Cruchaga, D.J. Celentano, R.W. Lewis, Modelling of twin-roll strip casting processes, Commun. Numer. Methods Eng. 19 (8) (2003) 623–635.

[1483] C.K. Jung, S.W. Jung, H.W. Nam, K.S. Han, Numerical modeling of heat transfer for squeeze casting of MMCs, J. Compos. Mater. 37 (6) (2003) 503–518.

[1484] S.M.H. Mirbagheri, N. Varahram, P. Davami, 3D computer simulation of melt flow and heat transfer in the lost foam casting process, Int. J. Numer. Methods Eng. 58 (5) (2003) 723–748.

[1485] M. Pohanka, K.A. Woodbury, A Downhill Simplex method for computation of interfacial heat transfer coefficients in alloy casting, Inverse Probl. Eng. 11 (5) (2003) 409–424.

[1486] X. Jin, L. Li, Y. Zhang, A heat transfer model for deep penetration laser welding based on an actual keyhole, Int. J. Heat Mass Transfer 46 (2003) 15–22.

[1487] A. De, S.K. Maiti, C.A. Walsh, H. Bhadeshia, Finite element simulation of laser spot welding, Sci. Technol. Weld. Join. 8 (5) (2003) 377–384.

[1488] V.K. Shiff, Determination of the volumetric heat generation in a furnace chamber from the radiation flux distribution, Tech. Phys. 48 (4) (2003) 393–398.

[1489] R. Leth-Miller, A.D. Jensen, P. Glarborg, L.M. Jensen, P.B. Hansen, S.B. Jorgensen, Investigation of a mineral melting cupola furnace. Part II. Mathematical modeling, Indus. Eng. Chem. Res. 42 (26) (2003) 6880–6892.

[1490] B.G. Zombori, F.A. Kamke, L.T. Watson, Simulation of the internal conditions during the hot-pressing process, Wood Fiber Sci. 35 (1) (2003) 2–23.

[1491] O. Meyer, A. Schneider, V. Uhlenwinkel, U. Fritsching, Convective heat transfer from a billet due to an oblique impinging circular jet within the spray forming process, Int. J. Therm. Sci. 42 (6) (2003) 561–569.

[1492] C. Shet, X.M. Deng, A.E. Bayoumi, Finite element simulation of high-pressure water-jet assisted metal cutting, Int. J. Mech. Sci. 45 (6–7) (2003) 1201–1228.

[1493] C.H. Chen, Convection cooling of a continuously moving surface in manufacturing processes, J. Mater. Process. Technol. 138 (Special Issue SI) (2003) 332–338.

[1494] D.W. Sun, Z.H. Hu, CFD simulation of coupled heat and mass transfer through porous foods during vacuum cooling process, Int. J. Refrig.-Rev. Int. Froid 26 (1) (2003) 19–27.

[1495] L.J. Wang, D.W. Sun, Numerical analysis of the three-dimensional mass and heat transfer with inner moisture evaporation in porous cooked meat joints during vacuum cooling, Trans. the Asae 46 (1) (2003) 107–115.

[1496] S.Y. He, Y.F. Li, Theoretical simulation of vacuum cooling of spherical foods, Appl. Therm. Eng. 23 (12) (2003) 1489–1501.

[1497] N.O. Moraga, H.G. Barraza, Predicting heat conduction during solidification of a food inside a freezer due to natural convection, J. Food Eng. 56 (1) (2003) 17–26.

[1498] M.L. Hoang, P. Verboven, M. Baelmans, B.M. Nicolai, A continuum model for airflow, heat and mass transfer in bulk of chicory roots, Trans. ASAE 46 (6) (2003) 1603–1611.

[1499] Y.C. Fu, C.H. Tong, D.B. Lund, Moisture migration in solid food matrices, J. Food Sci. 68 (8) (2003) 2497–2503.

[1500] E.M.A. Mokheimer, N.M. Abd El-Aziz, H.E.M. Amin, M.I. Salem, Freezing time calculations for various products, Int. J. Energy Res. 27 (12) (2003) 1117–1130.

[1501] C. Cogne, J. Andrieu, P. Laurent, A. Besson, J. Noequet, Experimental data and modelling of thermal properties of ice creams, J. Food Eng. 58 (4) (2003) 331–341.

[1502] S.E. Zorrilla, R.P. Singh, Heat transfer in double-sided cooking of meat patties considering two-dimensional geometry and radial shrinkage, J. Food Eng. 57 (1) (2003) 57–65.

[1503] P. Verboven, A.K. Datta, N.T. Anh, N. Scheerlinck, B.M. Nicolai, Computation of airflow effects on heat and mass transfer in a microwave oven, J. Food Eng. 59 (2–3) (2003) 181–190.

[1504] J.F. Velez-Ruiz, M.E. Sosa-Morales, Evaluation of physical properties of dough of donuts during deep-fat frying at different temperatures, Int. J. Food Prop. 6 (2) (2003) 341–353.

[1505] K.S. Chana, T.V. Jones, An investigation on turbine tip and shroud heat transfer, J. Turbomach.-Trans. ASME 125 (3) (2003) 513–520.

[1506] A.H. Gross, A. Osherov, A. Gany, Heat transfer amplification due to transverse mode oscillations, J. Thermophys. Heat Transfer 17 (4) (2003) 521–525.

[1507] Y. Okano, A. Yamaguchi, Numerical simulation of a free-falling liquid sodium droplet combustion, Ann. Nucl. Energy 30 (18) (2003) 1863–1878.

[1508] L. Thiery, N. Marini, Thermal behaviour modelling of tapered optical fibres for scanning near-field microscopy, Ultramicroscopy 94 (1) (2003) 49–69.

[1509] F. Ilinca, J.F. Hetu, F. Ajersch, Three-dimensional numerical simulation of turbulent flow and heat transfer in a continuous galvanizing bath, Numer. Heat Transfer Part A-Appl. 44 (5) (2003) 463–482.

[1510] C.A. Hall, E.P. Russo, C. Mackie, Maximum temperature rise in the reacted zone of electrochemical devices for space applications, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 177–181.

[1511] A. Bejan, Constructal tree-shaped paths for conduction and convection, Int. J. Energy Res. 27 (4) (2003) 283–299.

[1512] M. Bashahu, Statistical comparison of models for estimating the monthly average daily diffuse radiation at a subtropical African site, Solar Energy 75 (1) (2003) 43–51.

[1513] H. Beltrami, L. Kellman, An examination of short- and long-term air-ground temperature coupling, Global Planet. Change 38 (3–4) (2003) 291–303.

[1514] L. Diabate, J. Remund, L. Wald, Linke turbidity factors for several sites in Africa, Solar Energy 75 (2) (2003) 111–119.

[1515] A. Maafi, S. Harrouni, Preliminary results of the fractal classification of daily solar irradiances, Solar Energy 75 (1) (2003) 53–61.

[1516] R.J. Zamora, S. Solomon, E.G. Dutton, J.W. Bao, M. Trainer, R.W. Portmann, A.B. White, D.W. Nelson, R.T. McNider, Comparing MM5 radiative fluxes with observations gathered during the 1995 and 1999 Nashville southern oxidants studies—art. no. 4050, J. Geophys. Res.-Atmos. 108 (D2) (2003) 4050.

[1517] R. Petela, Exergy of undiluted thermal radiation, Solar Energy 74 (6) (2003) 469–488.

[1518] Y. Candau, On the exergy of radiation, Solar Energy 75 (3) (2003) 241–247.

[1519] C.A. Gueymard, Direct solar transmittance and irradiance predictions with broadband models. Part I: Detailed theoretical performance assessment, Solar Energy 74 (5) (2003) 355–379.

[1520] C.A. Gueymard, Direct solar transmittance and irradiance predictions with broadband models. Part II: validation with high-quality measurements, Solar Energy 74 (5) (2003) 381–395.

[1521] M. Ibanez, J.I. Rosell, W.A. Beckman, A bi-variable probability density function for the daily clearness index, Solar Energy 75 (1) (2003) 73–80.

[1522] T.S. L'Ecuyer, G.L. Stephens, The tropical oceanic energy budget from the TRMM perspective. Part I: Algorithm and uncertainties, J. Climate 16 (12) (2003) 1967–1985.

[1523] L. Mora-Lopez, M. Sidrach-de-Cardona, Using probabilistic finite automata to simulate hourly series of global radiation, Solar Energy 74 (3) (2003) 235–244.

[1524] L.R. Santigosa, J.P. Martinez, L.M. Lopez, M.S.D. Ortin, J.B. Galvez, Fuzzy inference systems applied to the daily ultraviolet radiation evaluation (295–385 nm) from daily global radiation, Solar Energy 75 (6) (2003) 447–454.

[1525] V. Gomez, A. Casanovas, Fuzzy modeling of solar irradiance on inclined surfaces, Solar Energy 75 (4) (2003) 307–315.

[1526] Y. Zhang, W.J. Chen, J. Cihlar, A process-based model for quantifying the impact of climate change on permafrost thermal regimes—art. no. 4695, J. Geophys. Res.-Atmos. 108 (D22) (2003) 4695.

[1527] I. Reda, T. Stoffel, D. Myers, A method to calibrate a solar pyranometer for measuring reference diffuse irradiance, Solar Energy 74 (2) (2003) 103–112.

[1528] C. Armenta-Deu, T. Donaire, J. Hernando, Thermal analysis of a prototype to determine radiative cooling thermal balance, Renew. Energy 28 (7) (2003) 1105–1120.

[1529] T. Bostrom, E. Wackelgard, G. Westin, Solution-chemical derived nickel–alumina coatings for thermal solar absorbers, Solar Energy 74 (6) (2003) 497–503.

[1530] S. Furbo, L.J. Shah, Thermal advantages for solar heating systems with a glass cover with antireflection surfaces, Solar Energy 74 (6) (2003) 513–523.

[1531] M. Khoukhi, S. Maruyama, S. Sakai, M. Behnia, Combined non-gray radiative and conductive heat transfer in solar collector glass cover, Solar Energy 75 (4) (2003) 285–293.

[1532] P.T. Tsilingiris, The total infrared transmittance of polymerised vinyl fluoride films for a wide range of radiant source temperature, Renew. Energy 28 (6) (2003) 887–900.

[1533] P.A. Waide, B. Norton, Variation of insolation transmission with glazing plane position and sky conditions, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 182–189.

[1534] O. Holck, S. Svendsen, S. Brunold, U. Frei, M. Kohl, M. Heck, H. Oversloot, Solar collector design with respect to moisture problems, Solar Energy 75 (4) (2003) 269–276.

[1535] D. Njomo, H.T.K. Tagne, Backscatter factor and absorption ratio of fibrous zirconia media in the visible, Heat Mass Transfer 40 (1–2) (2003) 1–7.

[1536] N.J. Rabadi, S.A. Mismar, Enhancing solar energy collection by using curved flow technology coupled with flow in porous media: an experimental study, Solar Energy 75 (3) (2003) 261–268.

[1537] S. Singh, M.A.R. Sharif, Mixed convective cooling of a rectangular cavity with inlet and exit openings on differentially heated side walls, Numer. Heat Transfer Part A-Appl. 44 (3) (2003) 233–253.

[1538] E. Torres-Reyes, J.J. Navarrete-Gonzalez, A. Zaleta-Aguilar, J.G. Cervantes-de Gortari, Optimal process of solar to thermal energy conversion and design of irreversible flat-plate solar collectors, Energy 28 (2) (2003) 99–113.

[1539] A.I. Kudish, E.G. Evseev, G. Walter, T. Priebe, Coaxial tubular solar collector constructed from polymeric materials: an experimental and transient simulation study, Energy Convers. Manage. 44 (16) (2003) 2549–2566.

[1540] C.W. Lei, J.C. Patterson, A direct three-dimensional simulation of radiation-induced natural convection in a shallow wedge, Int. J. Heat Mass Transfer 46 (7) (2003) 1183–1197.

[1541] P.C. Liu, Temperature distribution in a porous medium subjected to solar radiative incidence and downward flow: Convective boundaries, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 190–194.

[1542] T.T. Chow, Performance analysis of photovoltaic-thermal collector by explicit dynamic model, Solar Energy 75 (2) (2003) 143–152.

[1543] H.A. Zondag, D.W. de Vries, W.G.J. van Helden, R.J.C. van Zolingen, A.A. van Steenhoven, The yield of different combined PV-thermal collector designs, Solar Energy 74 (3) (2003) 253–269.

[1544] A. Narayanaswamy, G. Chen, Surface modes for near field thermophotovoltaics, Applied Physics Letters 82 (20) (2003) 3544–3546.

[1545] W. Durisch, B. Bitnar, F. von Roth, G. Palfinger, Small thermophotovoltaic prototype systems, Solar Energy 75 (1) (2003) 11–15.

[1546] W. Durisch, B. Bitnar, J.C. Mayor, F. von Roth, H. Sigg, H.R. Tschudi, G. Palfinger, Small self-powered grid-connected thermophotovoltaic prototype system, Applied Energy 74 (1–2) (2003) 149–157.

[1547] C. Bales, T. Persson, External DHW units for solar combisystems, Solar Energy 74 (3) (2003) 193–204.

[1548] B.P. Dougherty, A.H. Fanney, Experiences with using solar photovoltaics to heat domestic water, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 195–202.

[1549] W. Liu, J.H. Davidson, F.A. Kulacki, S.C. Mantell, Natural convection from a horizontal tube heat exchanger immersed in a tilted enclosure, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 67–75.

[1550] S. Medved, C. Arkar, B. Cerne, A large-panel unglazed roof-integrated liquid solar collector—energy and economic evaluation, Solar Energy 75 (6) (2003) 455–467.

[1551] D. Mills, G.L. Morrison, Optimisation of minimum backup solar water heating system, Solar Energy 74 (6) (2003) 505–511.

[1552] J. Razavi, M.R. Riazi, M. Mahmoodi, Rate of heat transfer in polypropylene tubes in solar water heaters, Solar Energy 74 (6) (2003) 441–445.

[1553] M. Smyth, P.C. Eames, B. Norton, Heat retaining integrated collector/storage solar water heaters, Solar Energy 75 (1) (2003) 27–34.

[1554] D.K. Baker, G.C. Vliet, Identifying and reducing scaling problems in solar hot water systems, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 61–66.

[1555] L.J. Shah, S. Furbo, Entrance effects in solar storage tanks, Solar Energy 75 (4) (2003) 337–348.

[1556] A. Zachar, I. Farkas, F. Szlivka, Numerical analyses of the impact of plates for thermal stratification inside a storage tank with upper and lower inlet flows, Solar Energy 74 (4) (2003) 287–302.

[1557] J.P. Chyng, C.P. Lee, B.J. Huang, Performance analysis of a solar-assisted heat pump water heater, Solar Energy 74 (1) (2003) 33–44.

[1558] S. Gadsden, M. Rylatt, K. Lomas, Putting solar energy on the urban map: a new GIS-based approach for dwellings, Solar Energy 74 (5) (2003) 397–407.

[1559] Y.J. Dai, K. Sumathy, Heat and mass transfer in the adsorbent of a solar adsorption cooling system with glass tube insulation, Energy 28 (14) (2003) 1511–1527.

[1560] C.H. Li, R.Z. Wang, Y.J. Dai, Simulation and economic analysis of a solar-powered adsorption refrigerator using an evacuated tube for thermal insulation, Renew. Energy 28 (2) (2003) 249–269.

[1561] A.A. Hasan, Y. Goswami, Exergy analysis of a combined power and refrigeration thermodynamic cycle driven by a solar heat source, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 55–60.

[1562] G. Tamm, D.Y. Goswami, S.G. Lu, A.A. Hasan, Novel combined power and cooling thermodynamic cycle for low temperature heat sources, Part I: Theoretical investigation, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 218–222.

[1563] G. Tamm, D.Y. Goswami, Novel combined power and cooling thermodynamic cycle for low temperature heat sources, Part II: Experimental investigation, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 223–229.

[1564] P. Mago, D.Y. Goswami, A study of the performance of a hybrid liquid desiccant cooling system using lithium chloride, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 129–131.

[1565] J.J. Rizza, Aqueous lithium bromide TES and R-123 chiller in series, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 49–54.

[1566] R.S. Tang, Y. Etzion, E. Erell, Experimental studies on a novel roof pond configuration for the cooling of buildings, Renew. Energy 28 (10) (2003) 1513–1522.

[1567] M. Li, R.Z. Wang, Heat and mass transfer in a flat plate solar solid adsorption refrigeration ice maker, Renew. Energy 28 (4) (2003) 613–622.

[1568] Y. Cerci, A new ideal evaporative freezing cycle, Int. J. Heat Mass Transfer 46 (16) (2003) 2967–2974.

[1569] B.L. Wang, M.Y. Zhang, X.T. Li, X.D. Yang, Experimental investigation of discharge performance and temperature distribution of an external melt ice-on-coil storage tank, Hvac&R Res. 9 (3) (2003) 291–308.

[1570] V. Badescu, Model of a thermal energy storage device integrated into a solar assisted heat pump system for space heating, Energy Convers. Manage. 44 (10) (2003) 1589–1604.

[1571] K. Kaygusuz, Phase change energy storage for solar heating systems, Energy Sources 25 (8) (2003) 791–807.

[1572] U. Stritih, Heat transfer enhancement in latent heat thermal storage system for buildings, Energy Build. 35 (11) (2003) 1097–1104.

[1573] P. Lamberg, K. Siren, Analytical model for melting in a semi-infinite PCM storage with an internal fin, Heat Mass Transfer 39 (2) (2003) 167–176.

[1574] M.C. Lin, L.J. Chun, W.S. Lee, S.L. Chen, Thermal performance of a two-phase thermosyphon energy storage system, Solar Energy 75 (4) (2003) 295–306.

[1575] A. Barba, M. Spiga, Discharge mode for encapsulated PCMs in storage tanks, Solar Energy 74 (2) (2003) 141–148.

[1576] G. Baran, A. Sari, Phase change and heat transfer characteristics of a eutectic mixture of palmitic and stearic acids as PCM in a latent heat storage system, Energy Convers. Manage. 44 (20) (2003) 3227–3246.

[1577] G.P. Henze, Parametric study of a simplified ice storage model, operating under conventional and optimal control strategies, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 2–12.

[1578] W. Liu, X.M. Huang, S.B. Riffat, Heat and mass transfer with phase change in a rectangular enclosure packed with unsaturated porous material, Heat Mass Transfer 39 (3) (2003) 223–230.

[1579] P.C. Ghosh, B. Emonts, H. Janssen, J. Mergel, D. Stolten, Ten years of operational experience with a hydrogen-based renewable energy supply system, Solar Energy 75 (6) (2003) 469–478.

[1580] P.C. Ghosh, Comparison of hydrogen storage with diesel-generator system in a PV-WEC hybrid system, Solar Energy 75 (3) (2003) 187–198.

[1581] J. Ward, A plastic solar water purifier with high output, Solar Energy 75 (5) (2003) 433–437.

[1582] S. Malato, J. Blanco, A. Vidal, D. Alarcon, M.I. Maldonado, J. Caceres, W. Gernjak, Applied studies in solar photocatalytic detoxification: an overview, Solar Energy 75 (4) (2003) 329–336.

[1583] S. Vijayaraghavan, D.Y. Goswami, Photocatalytic oxidation of toluene in water from an algae pond with high dissolved oxygen content, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 230–232.

[1584] E. Delyannis, Historic background of desalination and renewable energies, Solar Energy 75 (5) (2003) 357–366.

[1585] L. Garcia-Rodriguez, Renewable energy applications in desalination: state of the art, Solar Energy 75 (5) (2003) 381–393.

[1586] E. Tzen, R. Morris, Renewable energy sources for desalination, Solar Energy 75 (5) (2003) 375–379.

[1587] G.N. Tiwari, H.N. Singh, R. Tripathi, Present status of solar distillation, Solar Energy 75 (5) (2003) 367–373.

[1588] S. Al-Kharabsheh, D.Y. Goswami, Experimental study of an innovative solar water desalination system utilizing a passive vacuum technique, Solar Energy 75 (5) (2003) 395–401.

[1589] A.M. El-Nashar, Effect of dust deposition on the performance of a solar desalination plant operating in an arid desert area, Solar Energy 75 (5) (2003) 421–431.

[1590] M.F.A. Goosen, S.S. Sablani, C. Paton, J. Perret, A. Al-Nuaimi, I. Haffar, H. Al-Hinai, W.H. Shayya, Solar energy desalination for and coastal regions: development of a humidification-dehumidification seawater greenhouse, Solar Energy 75 (5) (2003) 413–419.

[1591] E. Mathioulakis, V. Belessiotis, Integration of solar still in a multi-source, multi-use environment, Solar Energy 75 (5) (2003) 403–411.

[1592] K. Voropoulos, E. Mathioulakis, V. Belessiotis, Solar stills coupled with solar collectors and storage tank analytical simulation and experimental validation of energy behavior, Solar Energy 75 (3) (2003) 199–205.

[1593] B. Bouchekima, A solar desalination plant for domestic water needs in arid areas of South Algeria, Desalination 153 (1–3) (2003) 65–69.

[1594] H.P. Garg, R.S. Adhikari, R. Kumar, Experimental design and computer simulation of multi-effect humidification (MEH)-dehumidification solar distillation, Desalination 153 (1–3) (2003) 81–86.

[1595] M.M. Naim, M.A.A. El Kawi, Non-conventional solar stills—Part 2. Non-conventional solar stills with energy storage element, Desalination 153 (1–3) (2003) 71–80.

[1596] G.N. Tiwari, S.K. Shukla, I.P. Singh, Computer modeling of passive/active solar stills by using inner glass temperature, Desalination 154 (2) (2003) 171–185.

[1597] M. Husain, P.S. Patil, S.R. Patil, S.K. Samdarshi, Optimum size of non-convective zone for improved thermal performance of salt gradient solar pond, Solar Energy 74 (5) (2003) 429–436.

[1598] M. Ouni, A. Guizani, H. Lu, A. Belghith, Simulation of the control of a salt gradient solar pond in the south of Tunisia, Solar Energy 75 (2) (2003) 95–101.

[1599] M.A. Punyasena, C.D. Amarasekara, J.R.P. Jayakody, P.A.A. Perera, P. Ehamparam, An investigation of rain and wind effects on thermal stability of large-area saltpan solar ponds, Solar Energy 74 (6) (2003) 447–451.

[1600] A. Spyridonos, A.A. Argiriou, J.K. Nickoletatos, Thermal storage efficiencies of two solar saltless water ponds, Solar Energy 75 (3) (2003) 207–216.

[1601] K. Schwarzer, M. Eugenia, V. da Silva, Solar cooking system with or without heat storage for families and institutions, Solar Energy 75 (1) (2003) 35–41.

[1602] A.N. Rao, S. Subramanyam, Solar cookers—Part 1: cooking vessel on lugs, Solar Energy 75 (3) (2003) 181–185.

[1603] D. Jain, G.N. Tiwari, Thermal aspects of open sun drying of various crops, Energy 28 (1) (2003) 37–54.

[1604] A. Walker, D. Renne, S. Bilo, C. Kutscher, J. Burch, D. Balcomb, R. Judkoff, C. Warner, Advances in solar buildings, J. Solar Energy Eng.-Trans. ASME 125 (3) (2003) 236–244.

[1605] K.W. Boer, G. Tamm, Solar conversion under consideration of energy and entropy, Solar Energy 74 (6) (2003) 525–528.

[1606] S. Ubertini, U. Desideri, Design of a solar collector for year-round climatization, Renew. Energy 28 (4) (2003) 623–645.

[1607] V. Badescu, B. Sicre, Renewable energy for passive house heating II. Model, Energy Build. 35 (11) (2003) 1085–1096.

[1608] T.Y. Chen, A method for the direct generation of comprehensive numerical solar building transfer functions, Solar Energy 74 (2) (2003) 123–132.

[1609] M. Hernandez, M.A. Medina, D.L. Schruben, Verification of an energy balance approach to estimate indoor wall heat fluxes using transfer functions and simplified solar heat gain calculations, Mathematical and Computer Modelling 37 (3–4) (2003) 235–243.

[1610] P.T. Tsilingiris, Thermal flywheel effects on the time varying conduction heat transfer through structural walls, Energy Build. 35 (10) (2003) 1037–1047.

[1611] A. Laouadi, M.R. Atif, A. Galasiu, Methodology towards developing skylight design tools for thermal and energy performance of atriums in cold climates, Build. Environ. 38 (1) (2003) 117–127.

[1612] R.S. Tang, I.A. Meir, Y. Etzion, Thermal behavior of buildings with curved roofs as compared with flat roofs, Solar Energy 74 (4) (2003) 273–286.

[1613] M. Ciampi, F. Leccese, G. Tuoni, Ventilated facades energy performance in summer cooling of buildings, Solar Energy 75 (6) (2003) 491–502.

[1614] D. Faggembauu, M. Costa, M. Soria, A. Oliva, Numerical analysis of the thermal behaviour of ventilated glazed facades in Mediterranean climates, Part I: development and validation of a numerical model, Solar Energy 75 (3) (2003) 217–228.

[1615] D. Faggembauu, M. Costa, M. Soria, A. Oliva, Numerical analysis of the thermal behaviour of glazed ventilated facades in Mediterranean climates, Part II: applications and analysis of results, Solar Energy 75 (3) (2003) 229–239.

[1616] M.H. Kim, C.Y. Oh, W.J. Yang, Thermal performance of a triple-glazed exhausting and ventilating airflow window system, J. Thermophys. Heat Transfer 17 (3) (2003) 402–406.

[1617] Y.J. Dai, K. Sumathy, R.Z. Wang, Y.G. Li, Enhancement of natural ventilation in a solar house with a solar chimney and a solid adsorption cooling cavity, Solar Energy 74 (1) (2003) 65–75.

[1618] M. Andersen, M. Rubin, J.L. Scartezzini, Comparison between ray-tracing simulations and bi-directional transmission measurements on prismatic glazing, Solar Energy 74 (2) (2003) 157–173.

[1619] K.A.R. Ismail, J.R. Henriquez, Modeling and simulation of a simple glass window, Solar Energy Mater. Solar Cells 80 (3) (2003) 355–374.

[1620] T. Mancini, P. Heller, B. Butler, B. Osborn, W. Schiel, V. Goldberg, R. Buck, R. Diver, C. Andraka, J. Moreno, Dish-Stirling systems: An overview of development and status, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 135–151.

[1621] F. Arqueros, A. Jimenez, A. Valverde, A novel procedure for the optical characterization of solar concentrators, Solar Energy 75 (2) (2003) 135–142.

[1622] D. Buie, C.J. Dey, S. Bosi, The effective size of the solar cone for solar concentrating systems, Solar Energy 74 (5) (2003) 417–427.

[1623] D. Buie, A.G. Monger, C.J. Dey, Sunshape distributions for terrestrial solar simulations, Solar Energy 74 (2) (2003) 113–122.

[1624] G. Johnston, K. Lovegrove, A. Luzzi, Optical performance of spherical reflecting elements for use with paraboloidal dish concentrators, Solar Energy 74 (2) (2003) 133–140.

[1625] A. Londono-Hurtado, A. Rivera-Alvarez, Maximization of exergy output from Volumetric Absorption Solar Collectors, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 83–86.

[1626] N. Rohner, A. Neumann, Measurement of high temperatures in the DLR solar furnace by UV-B detection, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 152–158.

[1627] P. Schramek, D.R. Mills, Multi-tower solar array, Solar Energy 75 (3) (2003) 249–260.

[1628] A. Segal, M. Epstein, Optimized working temperatures of a solar central receiver, Solar Energy 75 (6) (2003) 503–510.

[1629] B. Hoffschmidt, F.M. Tellez, A. Valverde, J. Fernandez, V. Fernandez, Performance evaluation of the 200-kW (th) HiTRec-II open volumetric air receiver, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 87–94.

[1630] T. Fend, B. Hoffschmidt, G. Jorgensen, H. Kuster, D. Kruger, R. Pitz-Paal, P. Rietbrock, K.J. Riffelmann, Comparative assessment of solar concentrator materials, Solar Energy 74 (2) (2003) 149–155.

[1631] T. Seo, S. Ryu, Y. Kang, Heat losses from the receivers of a multifaceted parabolic solar energy collecting system, KSME Int. J. 17 (8) (2003) 1185–1195.

[1632] M. Eck, E. Zarza, M. Eickhoff, J. Rheinlander, L. Valenzuela, Applied research concerning the direct steam generation in parabolic troughs, Solar Energy 74 (4) (2003) 341–351.

[1633] D. Kearney, U. Herrmann, P. Nava, P. Kelly, R. Mahoney, J. Pacheco, R. Cable, N. Potrovitza, D. Blake, H. Price, Assessment of a molten salt heat transfer fluid in a parabolic trough solar field, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 170–176.

[1634] R.G. Reddy, Z.J. Zhang, M.F. Arenas, D.M. Blake, Thermal stability and corrosivity evaluations of ionic liquids as thermal energy storage media, High Temperat. Mater. Process. 22 (2) (2003) 87–94.

[1635] L. Moens, D.M. Blake, D.L. Rudnicki, M.J. Hale, Advanced thermal storage fluids for solar parabolic trough systems, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 112–116.

[1636] V.M.B. Nunes, M.J.V. Lourenco, F.J.V. Santos, C.A.N. de Castro, Importance of accurate data on viscosity and thermal conductivity in molten salts applications, J. Chem. Eng. Data 48 (3) (2003) 446–450.

[1637] S. Natan, D. Barnea, Y. Taitel, Direct steam generation in parallel pipes, Int. J. Multiphase Flow 29 (11) (2003) 1669–1683.

[1638] C.G. Camacho, Some consequences from the thermodynamics of the synthesis of solar fuels, Solar Energy 75 (2) (2003) 103–109.

[1639] D. Hirsch, P. von Zedtwitz, T. Osinga, J. Kinamore, A. Steinfeld, A new 75 kW high-flux solar simulator for high-temperature thermal and thermochemical research, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 117–120.

[1640] S. Kraupl, A. Steinfeld, Operational performance of a 5-kW solar chemical reactor for the co-production of zinc and syngas, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 124–126.

[1641] C. Wieckert, A. Meier, A. Steinfeld, Indirectly irradiated solar receiver-reactors for high-temperature thermochemical processes, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 120–123.

[1642] P.L. Spath, W.A. Amos, Using a concentrating solar reactor to produce hydrogen and carbon black via thermal decomposition of natural gas: Feasibility and economics, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 159–164.

[1643] A. Segal, M. Epstein, Solar ground reformer, Solar Energy 75 (6) (2003) 479–490.

[1644] A.J. Gannon, T.W. von Backstrom, Solar chimney turbine performance, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 101–106.

[1645] M.A.D. Bernardes, A. Voss, G. Weinrebe, Thermal and technical analyses of solar chimneys, Solar Energy 75 (6) (2003) 511–524.

[1646] K.S. Ong, C.C. Chow, Performance of a solar chimney, Solar Energy 74 (1) (2003) 1–17.

[1647] K.S. Ong, A mathematical model of a solar chimney, Renew. Energy 28 (7) (2003) 1047–1060.

[1648] T.W. von Backstrom, A. Bernhardt, A.J. Gannon, Pressure drop in solar power plant chimneys, J. Solar Energy Eng.-Trans. ASME 125 (2) (2003) 165–169.

[1649] T.W. von Backstrom, Calculation of pressure and density in solar power plant chimneys, J. Solar Energy Eng.-Trans. ASME 125 (1) (2003) 127–129.

[1650] V. Barantsevich, V. Shabalkin, Heat pipes for thermal control of ISS solar battery drive, Appl. Therm. Eng. 23 (9) (2003) 1119–1123.

[1651] H.T. Cui, X.B. Hou, X.G. Yuan, Energy analysis of space solar dynamic heat receivers, Solar Energy 74 (4) (2003) 303–308.

[1652] Y.T. Wu, J.X. Ren, Z.Y. Guo, X.G. Liang, Optimal analysis of a space solar dynamic power system, Solar Energy 74 (3) (2003) 205–215.

[1653] H.T. Cui, X.G. Yuan, X.B. Hou, Thermal performance analysis for a heat receiver using multiple phase change materials, Appl. Therm. Eng. 23 (18) (2003) 2353–2361.

[1654] X. Chen, H.P. Li, The reactive thermal conductivity for a two-temperature plasma, Int. J. Heat Mass Transfer 46 (8) (2003) 1443–1454.

[1655] A. Bogaerts, Z.Y. Chen, R. Gijbels, Glow discharge modelling: from basic understanding towards applications, Surf. Interf. Anal. 35 (7) (2003) 593–603.

[1656] K. Fujita, S. Sato, T. Abe, H. Otsu, Electron density measurements behind strong shock waves by H-beta profile matching, J. Thermophys. Heat Transfer 17 (2) (2003) 210–216.

[1657] H. Nishiyama, T. Sato, K. Takamura, Performance evaluation of arc-electrodes systems for high temperature materials processing by computational simulation, ISIJ Int. 43 (6) (2003) 950–956.

[1658] A.M. Essiptchouk, L.I. Sharakhovsky, A. Marotta, Working conditions of a copper cathode with minimum erosion, Plasma Sour. Sci. Technol. 12 (4) (2003) 501–507.

[1659] T.S. Fisher, D.G. Walker, R.A. Weller, Analysis and simulation of anode heating due to electron field emission, IEEE Trans. Compon. Packag. Technol. 26 (2) (2003) 317–323.

[1660] G.S. Eom, C.W. Park, Y.H. Shin, K.H. Chung, S. Park, W. Choe, J.W. Hahn, Size determination of nanoparticles in low-pressure plasma with laser-induced incandescence technique, Applied Physics Letters 83 (6) (2003) 1261–1263.

[1661] H.P. Li, E. Pfender, X. Chen, Application of Steenbeck's minimum principle for three-dimensional modelling of DC arc plasma torches, J. Physics D-Applied Physics 36 (9) (2003) 1084–1096.

[1662] X. Chen, H.P. Li, Three-dimensional flow and heat transfer in thermal plasma systems, Surf. Coat. Technol. 171 (1–3) (2003) 124–133.

[1663] R.L. Williamson, J.R. Fincke, D.M. Crawford, S.C. Snyder, W.D. Swank, D.C. Haggard, Entrainment in high-velocity, high-temperature plasma jets, Part II: computational results and comparison to experiment, Int. J. Heat Mass Transfer 46 (22) (2003) 4215–4228.

[1664] J.R. Fincke, D.M. Crawford, S.C. Snyder, W.D. Swank, D.C. Haggard, R.L. Williamson, Entrainment in high-velocity, high-temperature plasma jets, Part I: experimental results, Int. J. Heat Mass Transfer 46 (22) (2003) 4201–4213.

[1665] Y.P. Wan, S. Sampath, V. Prasad, R. Williamson, J.R. Fincke, An advanced model for plasma spraying of functionally graded materials, J. Mater. Process. Technol. 137 (1–3) (2003) 110–116.

[1666] K. Ramachandran, N. Kikukawa, H. Nishiyama, 3D modeling of plasma–particle interactions in a plasma jet under dense loading conditions, Thin Solid Films 435 (1–2) (2003) 298–306.

[1667] K. Ramachandran, T. Sato, H. Nishiyama, 3D modeling of evaporation of water injected into a plasma jet, Int. J. Heat Mass Transfer 46 (9) (2003) 1653–1663.

[1668] J. Amouroux, S. Dresvin, D. Morvan, L. Ouvrelle, D. Ivanov, S. Zverev, O. Feigenson, A. Balashov, Calculation of silicon particles dynamics, heat and mass transfers in thermal plasmas: effect of particles vaporization, High Temperat. Mater. Process. 7 (1) (2003) 93–105.

[1669] T. Sato, O.P. Solonenko, H. Nishiyama, Numerical simulation of a particle–laden plasma flow in a complex configuration under an electromagnetic field, Int. J. Multiphase Flow 29 (3) (2003) 461–474.

[1670] M.P. Planche, R. Bolot, C. Coddet, In-flight characteristics of plasma sprayed alumina particles: measurements, modeling, and comparison, J. Therm. Spray Technol. 12 (1) (2003) 101–111.

[1671] P.V. Ananthapadmanabhan, T.K. Thiyagarajan, K.P. Sreekumar, R.U. Satpute, N. Venkatramani, K. Ramachandran, Co-spraying of alumina–titania: correlation of coating composition and properties with particle behaviour in the plasma jet, Surf. Coat. Technol. 168 (2–3) (2003) 231–240.

[1672] X. Meng, W.X. Pan, C.K. Wu, Heat transfer from a dc laminar plasma-jet flow to different solid surfaces, Chin. Phys. Lett. 20 (5) (2003) 685–687.

[1673] Y. Li, R.J. Fruehan, Computational fluid-dynamics simulation of postcombustion in the electric-arc furnace, Metall. Mater. Trans. B-Process Metall. Mater. Process. Sci. 34 (3) (2003) 333–343.

[1674] M. Ramirez, G. Trapaga, Mathematical modeling of a DC electric arc—dimension less representation of a DC arc, ISIJ Int. 43 (8) (2003) 1167–1176.

[1675] A. Blais, P. Proulx, M.I. Boulos, Three-dimensional numerical modelling of a magnetically deflected dc transferred arc in argon, J. Phys. D-Appl. Phys. 36 (5) (2003) 488–496.

[1676] D. Neuschutz, D. Spirin, Nitrogen removal and arc voltage increase in EAF steelmaking by methane injection into the arc, Steel Res. Int. 74 (1) (2003) 19–25.

[1677] M. Tanaka, H. Terasaki, M. Ushio, J.J. Lowke, Numerical study of a free-burning argon arc with anode melting, Plasma Chem. Plasma Process. 23 (3) (2003) 585–606.

[1678] M.H. McCay, C.M. Sharp, J.A. Hopkins, B. Szapiro, T.D. McCay, Plasma assisted laser surface alloying, J. Laser Appl. 15 (2) (2003) 84–88.

[1679] N. Ghaddar, E. Sawaya, Testing and modeling thermosyphonic closed-loop magnetohydrodynamic electrolyte flow, J. Thermophys. Heat Transfer 17 (2) (2003) 129–137.

[1680] U. Burr, L. Barleon, P. Jochmann, A. Tsinober, Magnetohydrodynamic convection in a vertical slot with horizontal magnetic field, J. Fluid Mech. 475 (2003) 21–40.

[1681] O. Andreev, A. Thess, C. Haberstroh, Visualization of magnetoconvection, Phys. Fluids 15 (12) (2003) 3886–3889.

[1682] J.F. Dietiker, K.A. Hoffmann, Modified one-equation turbulence models for turbulent magnetohydrodynamic flows, J. Thermophys. Heat Transfer 17 (4) (2003) 509–520.

[1683] J. Cho, A. Lazarian, A. Honein, B. Knaepen, S. Kassinos, P. Moin, Thermal conduction in magnetized turbulent gas, Astrophys. J. 589 (2 Part 2) (2003) L77–L80.

[1684] P. Sharma, C.L. Varshney, Thermal dispersion effect on MHD flow of dusty gas and dust particles through hexagonal channel, Int. J. Heat Mass Transfer 46 (13) (2003) 2511–2514.

[1685] H.A. Attia, A.L. Aboul-Hassan, The effect of variable properties on the unsteady Hartmann flow with heat transfer considering the Hall effect, Appl. Math. Modell. 27 (7) (2003) 551–563.

[1686] C.Y. Chen, C.Y. Liao, Motion of miscible magnetic fluids in a dynamic magnetic field, Int. J. Numer. Methods Heat Fluid Flow 13 (2–3) (2003) 244–261.

[1687] M. Ishikawa, K. Itoh, Three dimensional constricted electric current near anode and cathode of Faraday MHD generator, Energy Convers. Manage. 44 (13) (2003) 2111–2124.

[1688] K. Sundaravadivelu, P. Kandaswamy, Magnetoconvective flow of a liquid metal in partially open cavities, Z. Angew. Math. Mech. 83 (6) (2003) 423–432.

[1689] Y. Ke, H.Y. Wang, Y.C. Wu, MHD simulation of the liquid metal/helium gas dual-cooled waste transmutation blanket for FDS, Fusion Eng. Design 69 (1–4) (2003) 431–435.

[1690] S.P.A. Devi, R. Kandasamy, Effects of chemical reaction, heat and mass transfer on non-linear MHD flow over an accelerating surface with heat source and thermal stratification in the presence of suction or injection, Commun. Numer. Methods Eng. 19 (7) (2003) 513–520.

[1691] H.S. Takhar, S. Roy, G. Nath, Unsteady free convection flow over an infinite vertical porous plate due to the combined effects of thermal and mass diffusion, magnetic field and Hall currents, Heat Mass Transfer 39 (10) (2003) 825–834.

[1692] A.K. Singh, Hydromagnetic free convection and mass transfer flow past a porous plate with temperature gradient dependent heat source, Indian J. Pure Appl. Phys. 41 (7) (2003) 509–514.

[1693] C. Israel-Cookey, A. Ogulu, V.B. Omubo-Pepple, Influence of viscous dissipation and radiation on unsteady MHD free-convection flow past an infinite heated vertical plate in a porous medium with time-dependent suction, Int. J. Heat Mass Transfer 46 (13) (2003) 2305–2311.

[1694] A.A. Megahed, S.R. Komy, A.A. Afify, Similarity analysis in magnetohydrodynamics: Hall effects on free convection flow and mass transfer past a semi-infinite vertical flat plate, Int. J. Non-Linear Mech. 38 (4) (2003) 320–513.

[1695] N.T. Eldabe, A.G. El-Sakka, A. Fouad, Numerical treatment of the MHD convective heat and mass transfer in an electrically conducting fluid over an infinite solid surface in presence of the internal heat generation, Z. Naturforsch. Section A-J. Phys. Sci. 58 (11) (2003) 601–611.

[1696] M.F. El-Amin, Combined effect of viscous dissipation and Joule heating on MHD forced convection over a non-isothermal horizontal cylinder embedded in a fluid saturated porous medium, J. Magn. Magn. Mater. 263 (3) (2003) 337–343.

[1697] R.N. Jat, A.K. Jankal, Three-dimensional free convective MHD flow and heat transfer through a porous medium, Indian J. Eng. Mater. Sci. 10 (2) (2003) 138–142.

[1698] S.J. Liao, On the analytic solution of magnetohydrodynamic flows of non-Newtonian fluids over a stretching sheet, J. Fluid Mech. 488 (2003) 189–212.

[1699] S.K. Khan, M.S. Abel, R.M. Sonth, Visco-elastic MHD flow, heat and mass transfer over a porous stretching sheet with dissipation of energy and stress work, Heat Mass Transfer 40 (1–2) (2003) 47–57.

[1700] N.T.M. Eldabe, G.M. Moatimid, H.S.M. Ali, Magnetohydrodynamic flow of non-Newtonian visco-elastic fluid through a porous medium near an accelerated plate, Can. J. Phys. 81 (11) (2003) 1249–1269.