# Conference Report

## Conference Information

### *NIST Conferences*

The National Institute of Standards and Technology (NIST) is an agency of the Department of Commerce's Technology Administration. For general information on all NIST conferences, contact Kathleen D. Kilmer or Patrice S. Boulanger, Public and Business Affairs, B116 Administration Bldg. (101), NIST, Gaithersburg, MD 20899-0001; tel: 301/975-2776.

### *Measurement Quality Conference at NIST*

Measurement Quality Conference, NIST Gaithersburg, MD, 9-11 Sept 1997.

*Purpose:* To provide a forum for presenting and discussing ideas and current topics on the quality of measurements and measurement of quality, for quality professionals.

*Topics:* Quality measurement, software for quality, data analysis, uncertainty determination, management process statistics, and physical measurement technology.

**Technical Contact:** Norman Belecki, NIST, Bldg. 220, Rm. B146; Gaithersburg, MD 20899-0001; tel: 301/975-4223; fax: 301/926-3972; e-mail: norman.@nist.gov.

### *HVOF Spray Conference in Germany*

Erding, Germany, 13-14 Nov 1997

*Proven Concepts, New Developments, Improved Cost Effectiveness*

In recent years, a new generation of spray coatings and spray systems has increased the importance of high-velocity oxyfuel flame spraying in the field of surface technology. As a result of the continuous development of spray materials and spray systems, it has been possible to open up a number of new applications for the field of thermal spraying. New developments in equipment and materials technology will be introduced at the 4th Conference on "High Velocity Oxyfuel Flame Spraying." Other topics include: process fundamentals and the potential for improving coating characteristics; criteria for selecting the correct materials and the optimal fuel gases; broad overview of current and proven concepts, covering all quality-management issues (training, standardization, certification) and all the aspects of cost-effective thermal spraying.

In the lectures, manufacturing experts and high-velocity oxyfuel flame spray users will jointly discuss industrial examples and clarify the reasons the spray system in question was chosen for a particular application and—individually adapted—why it represents the optimal solution. The lectures will be followed by discussions. The lecture program includes simultaneous translation in English and German and will be complemented by a exhibition of HVOF systems and components. The fringe program offers ample opportunity to exchange know-how and to make important contacts. The detailed program appears below.

- Dir. Dr. R. Schlicher (Linde AG, Höllriegelskreuth) and Prof. Dr. D. Böhme (SLV München GmbH, München), Welcoming speech for participants at Stadthalle Erding.
- Prof. Dr. H.J. Richter (Dartmouth College, Hanover, NH), "Fundamental Thermodynamic and Fluid Dynamic Concepts Related to High Velocity Oxyfuel Flame Spraying"; including characteristic features of supersonic flow, behavior of solid particles in the jet, influence of spraying parameters on the temperature and velocity of the particles, and use of modern computer calculation methods to optimize spray systems and spray parameters.
- Prof. Dr. H. Kreye (Universität der Bundeswehr, Hamburg), "Comparison of HVOF Systems—Materials Behavior and Coating Characteristics"; including overview of the various HVOF systems and their particular characteristics; influence of particle temperature and velocity on the microstructure of the coating; relationship between microstructure and coating properties; and potential and limits of high velocity oxyfuel flame spraying.
- R. Schwetzke (Universität der Bundeswehr, Hamburg) and W. Krömmer (Linde AG, Höllriegelskreuth); "Techniques for Optimizing and Assessing Coating Properties"; including process control techniques, methods for characterizing the microstructure and the properties of the coatings, and approach for optimizing coating properties.

- Dr. H. Keller and J. Beczkowiak (H.C. Starck, Laufenburg), "Powder for High-Velocity Oxyfuel Flame Spraying"; including production and morphology of the various powder types, characterization of powders, overview of available powders, quality characteristics and selection criteria, and new developments and applications.
- H. Meinaß and P. Heinrich (Linde AG, Höllriegelskreuth), "Gases for High-Velocity Oxyfuel Flame Spraying"; including characteristics of the various gases, market situation, availability, costs, supply concepts and use of $CO_2$ for blasting and cooling.
- Prof. Dr. D. Böhme and A. Ohliger (SLV München GmbH, München), "Quality Management for Thermal Spraying Using Guidelines, Standardization, Training, and Certification"; including EWF guidelines for training levels, periods, and contents, EWF qualifications, applications in the factory; application and QM standards: sprayer certification test quality requirements from TS products, spraying supervision—tasks and responsibility, and TS operations and certification.
- R. Heinrich (GTS, Höllriegelskreuth), "GTS—A Competitive Edge"; including objectives of the Gemeinschaft Thermisches Spritzen, market strategy and acceptance, certification of spraying operations, and marketing end public relations.
- "HVOF Spraying from the Contractors Perspective"; including presentation of applications in various branches of industry, reasons for choosing the HVOF process (quality, cost effectiveness, advantages over other processes), and the coating process: from selection of the powder and preparation of the coating to finishing and quality control.
- R. McIntyre (Plasma & Thermal Coating Ltd., Newport, UK); "Practice of High-Velocity Oxyfuel Flame Spraying from the Contractor's Point of View."
- D. Wieczorek and Dr. H. Reimann (Gotek GmbH, Frankfurt); "Development and Application of HVOF Spray Coating in Practice."
- Prof. Dr. H. Kreye (Universität der Bundeswehr, Hamburg); "Discussion of the Practice Lectures."
- "System Manufacturers"; including design and operation of the spray guns, usable fuel gases/fuels and powders, methods to measure and document process parameters, control and safety specification aspects, approval, and technical aspects of the equipment for certain materials and applications.
- "Users"; including listing and short clarification of a large number of examples from various sectors of industry, examples of the influence of powder, substrate preparation, spraying parameters and of finishing of coatings on the quality of the coatings, and presentation of the advantages of the particular system for these special applications (coating quality cost effectiveness, etc.).
- D.A. Lee (Deloro Stellite, Goshen, IN) and Dr. H. Bick (Deloro Stellite GmbH, Koblenz); "Jet Kote Thermal Spray Coatings—Properties and Functions In Aggressive Environment."
- K. Nassenstein (GTV mbH, Luckenbach) and H.-P. Isch (Fritz Buser AG, Wiler, Schweiz); "Advantages and Possibilities Using the GTV-Control for HVOF Spraying with TOP-GUN Torches."
- Dr. M.C. Nestler (Sulzer Metco GmbH, Hattersheim) and R. Henriksen (Bandak AS, Lunde, Norway); "Characteristics and Progressive Industrial Applications of the Diamond Jet Hybrid—The New Generation of Gas-Powered HVOF Systems."
- M.J. Breitsameter (Hobart Tafa Technologies, Concord, NH) and M. Prosperini (Flame Spray S.N.C., Roncello, Italy); "JP-5000, the HVOF System for the 21st Century."
- G. Matthäus (OSU Maschinenbau GmbH, Castrop-Rauxel) and G. Stevens (Barlows Equipment Manufacturing Co., Bokburg, South Africa ); "OSU Super Jet System SJS and Carbide Jet System CJS."
- Prof. Dr. D. Böhme, (SLV München GmbH, München); closing discussion concerning the conference.

Conference fees: DM 960, GTS members DM 660, students and senior citizens DM 220. The fees cover the conference documentation, Bavarian refreshments, coffee and evening buffet with drinks (day 1), coffee with snacks and lunchtime buffet with drinks (day 2).

**Contact:** P. Heinrich, Reference: "HG-Flammspritzen," Linde AG Werksgruppe Technische Gase, Seitnerstr. 70, D 82049 Höllriegelskreuth; tel: 089/7446-1428; fax: 089/7446-1659.

### *Solidification and Deposition of Molten Metal Droplets*

A symposium on Solidification and Deposition of Molten Metal Droplets will be held at the TMS Annual Meeting, San Antonio, TX, 14-19 Feb 1998. The symposium is sponsored by both the Solidification Committee and the Synthesis, Control, and Analysis in Material Processing Committee of TMS.

This symposium will cover two aspects of the technology: (1) solidification behavior of undercooled metal droplets produced by techniques such as: atomization, spray forming, thermal spray, uniform droplet spray, levitation (electromagnetic, electrostatic, gas flow), electrohydrodynamic spray, and emulsification, and (2) the impact and solidification behavior of partially solidified droplets during deposition. Although the principal interest is in droplet size ranging from submicron to millimeters, papers dealing with materials in bulk form are also encouraged. Topics of interest include commercial alloy compositions, influence of processing parameters on undercooling, influence of droplet size and alloying elements on undercooling, influence of undercooling of microstructure during droplet formation and deposition, the effect of fraction solid on impingement, microstructural evolution during deposition, droplet-substrate interaction, and porosity formation.

**Contact:** Dr. Men G. Chu, Molten Metal Processing Center, Alcoa Technical Center, 100 Technical Dr., Alcoa Center, PA 15069-0001; tel: 412/337-2266; fax: 412/337-4063; Prof. Enrique J. Lavernia, Dept. of Chemical Engineering & Materials Science, University of California at Irvine, Irvine, CA 92717-2575; tel: 714/824-8714; fax: 714/824-2262; or Prof. Jung-Hoon Chun, Dept. of Mechanical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Ave., Room 35-233, Cambridge, MA 02139; tel: 617/253-1759; fax: 617/253-2123; e-mail: jchun@mit.edu.

### *Materials Research*

The 4th IUMRS International Conference in Asia, Makuhari, Chiba, Japan, 16-18 Sept 1997, is organized by Materials Research Society of Japan (MRS-J) and The International Union of Materials Research Societies (IUMRS). The scope of the Conference includes experimental and theoretical studies on various materials, materials characterization, application, and processing. Attendees may team and exchange information with others from a broad spectrum of materials research.

**Contact:** Secretariat, IUMRS-ICA-97, Dr. Masatomo Yashima, General Secretary, Materials and Structures Laboratory Tokyo Institute of Technology, 4259 Nagatsuta, Midori Yokohama 226, Japan; tel: +81-45-924-5323; fax: +81-45-924-5358; e-mail: iumrsl@rlem. titech.ac.jp.

### *Discover Ceramics*

Discover Ceramics '97, 23-25 Sept 1997, Greater Columbus Convention Center.

**Contact:** David Lurie, Group Publisher, Business News Publishing Co., 5900 Harper Rd., Suite 109, Solon, OH 44139; tel: 810/244-6461, 216/498-9214; fax: 216/498-9121.

### *Ceramitec '97, Munich*

Ceramitec '97, 14-18 Oct 1997, 7th International Trade Fair for Machinery, Equipment, Plant, Processes and Raw Materials for Ceramics and Powder Metallurgy.

The main events at the congress include: (1) 6th International Ceramitec Symposium, "Ceramics Production—A Changing Industry," (2) EURO PM97, "European Conference on Advances in Structural PM Component," (3) PIM97, "1st European Symposium on Powder Injection Molding," (4) Annual Convention of the Deutsche Keramische Gesellschaft, (5) D.A.CH—Convention of the Roof-Tile Industry, and (6) Convention of the executive committee of the European Association of Manufacturers of Refractory Products (PRE).

**Contact:** Messe München GmbH, Messegelande, 80325 München, Germany; tel: (+49 89) 5107-0; fax (+49 89) 5107-506; e-mail: info@messe-muenchen.de.

### *Education in Manufacturing*

International Conference on Education in Manufacturing, 14-16 Oct 1998. San Diego, CA. Conference Co-Chairs: M. Eugene Merchant, Institute of Advanced Manufacturing Sciences, Inc. Gustav J. Olling, Chrysler Corporation.

The purpose of the conference is to stimulate and enhance curriculum development that prepares students to be world-class contributing members of the global manufacturing workforce in the 21st Century. It is an international forum for education, industry, and government leaders to exchange data and models for manufacturing education and research and address innovative solutions to the problems involved with preparing a workforce of manufacturing professionals who meet industry's needs.

This conference will also feature demonstrations of manufacturing courseware and multimedia resources. Sessions that focus on industry-driven needs for manufacturing education, innovative models, and approaches for teaching and benchmarking programs, and worldwide partnerships will be highlighted.

**Contact:** Mark Stratton; tel: 313/271-1500, ext. 506; fax: 313/271-2861; e-mail: stramar@sme.org.

### *International Conference on Surface Engineering*

ICSE Shanghai '97 addresses the rapid economic growth and technological changes that accelerate the design and manufacturing of world-class products and to bring together engineers and researchers to forecast the perspective of surface engineering towards the 21st century.

*Topics include:* Fundamental research in surface engineering, advanced manufacturing technologies, energy- and material-saving techniques, environmental protection technologies, hybrid surface techniques, technical design in surface engineering, surface protection and treatment, application of surface engineering in various industrial sectors, methods of evaluating surface coating properties and microstructures, and developments on surface engineering equipment, instruments, and new materials.

**Contact:** Dr.-Ing. Peifan Ding, Deputy General Secretary, The Chinese Mechanical Engineering Society, 46 Sanlihe Rd., Beijing 100823, The People's Republic of China; tel: (86 10) 6859-5318; fax (86 10) 6859-5314.

### *Advanced Turbines Conference*

Federal Energy Technology Center, Morgantown, WV, 28-29 Oct 1997.

A two-day program review of DoE's Advanced Turbine System (ATS) projects. An opportunity to meet major players in the field and get briefed on latest developments on one of the major DoE programs. ATS Program goals are: to complete the development and demonstration of ultrahigh efficiency natural gas turbine systems for commercial offering to electric utilities, independent power producers, and industries by the year 2000.

*Major Participants:* Allison Engine Company Asea Brown Boveri; General Electric Company; Solar Turbines Inc.; United Technologies Pratt & Whitney; Westinghouse Electric Corporation; Howmet Corporation; and PCC Airfoils, Inc.

*Focus Areas:* Utility/industrial scale ATS, materials development, advanced gas turbine system integration, O/M issues, policy and strategic issues, market forces—deregulation, and university/industry research.

**Contact:** Conference Services, Federal Energy Technology Center, P.O. Box 880, MS-KO7, Morgantown, WV 26505-0880; tel: 304/285-4108; fax: 304/285-4459; WWW: http://www. fetc.doe.gov.

### *Science and Technology of Thermal Spray Materials Processing*

Boston, MA, 1-5 Dec 1997.

A symposium will be convened on Thermal Spray Science and Technology as part of the Fall 1997 MRS Meeting. This will be the first such MRS Symposium dedicated to thermal spray per se, and, as such, it is the goal of the organizers that there be representation from both the coatings and the materials science communities. The Symposium is being oriented to a wider-ranging audience than is usual for a thermal spray meeting and thus we hope to have your participation and assistance. The endorsement of ASM's Thermal Spray Society in this endeavor is gratefully acknowledged. Please feel free to contact any of the organizers to discuss your ideas and suggestions. It is your Symposium!

The protection of engineering materials by coatings has allowed structures to function under extreme conditions and has made feasible the introduction of novel base materials into high-performance applications. Thermal spray surfacing represents a practical means of satisfying stringent design criteria for operating under extreme environments (e.g., high temperatures, wear, corrosion) and introducing a multiplicity of functions (e.g., thermal barriers, biomedical implants, electronic, magnetic). The impetus to expand the use of thermal spray coatings has created the need to elevate the level of the scientific base of the technology. There is a large international community engaged in thermal spray research, from flame-particle diagnostics to characterization and properties studies.

This Symposium will also address closely allied and complementary spray and beam processing technologies with the additional emphasis on direct fabrication of hardware from electronic media renditions of design concepts. Several technologies are under development (e.g., laser engineered net shaping) using this approach, both for structural shapes and electronic components.

Contributed papers are solicited in the following and related areas: fundamentals of particle-flame interactions; modeling and diagnostics; processing science and technologies; intelligent process control; experimental and theoretical studies of rapid solidification and deposit formation; physics and chemistry of deposit interfaces and metastable phases and imperfections (e.g., porosity, cracks, debonding); nanoparticulates and nanodeposits formed by thermal spray methods; reactive spraying and in-flight chemical synthesis; mechanical, thermal, chemical, electric, dielectric, magnetic properties; functional graded materials, laminates and sprayed forms; thermal beam processing for rapid prototyping and direct fabrication; and advanced applications.

Invited speakers: B. Beardsley (Caterpillar), M. Boulos (University of Sherbrooke), W. Brindley (NASA-Lewis), M. Cieslak (Sandia), A. Evans (Harvard), J. Fincke (INEL), J. Heberlein (University of Minnesota), G. Long (NIST), J.R. Smith (GM Research), H.-D. Steffens (University of Dortmund), S. Suresh (MIT), and A. Vardelle (University of Limoges).

Special sessions are being organized focusing on functionally graded materials, thermal barrier coatings, alternative processes, nanoparticulate spray processing, and advanced industrial applications.

**Contact:** Herbert Herman, Center for Thermal Spray Research, Department of Materials Science, State University of New York at Stony Brook, Stony Brook, NY 11794-2275; tel: 516/632-8480; fax: 516/632-7878; e-mail: hherman@ccmail.sunysb.edu; Richard A. Neiser, Sandia National Laboratories, MS 49-3 Albuquerque, NM 87185; tel: 505/845-0457; fax: 505/845-3130; e-mail: raneise@sandia.gov; Emil Pfender, Department of Mechanical Engineering, University of Minnesota, 111 Church St., Minneapolis, MN 55455; tel: 612/625-6012; fax: 612/624-1398; e-mail: pfender@maroon.tc.umn.edu; or Richard E. Teets, General Motors Research Laboratories, Physics Department, Box 9055, 30500 Mound Rd., Warren, MI 48090-9055; tel: 810/98- 0613; fax: 810/986-3091.

### *Composites, Advanced Ceramics, Materials and Structures*

Cocoa Beach, FL, 20-24 Jan 1998.

**Contact:** The American Ceramic Society, P.O. Box 6136, Westerville, OH 43086-6116; tel: 614/794-5880; fax: 614/899-6109; WWW: http://www.acers.org.

### *Science of Hard Materials*

Lanzarote, Canarian Islands, Spain, 9-14 March 1998.

The Sixth International Conference on the Science of Hard Materials will focus on the basic properties, applications, production, and development of hard materials. The objective is to provide an interdisciplinary forum for the presentation, discussion, and exchange of theoretical and applied information and ideas that will benefit continued evolution of the field. In addition to discussing current and ongoing research and development in the science of hard materials, this forum expects to encourage discussion on anticipating and overcoming the technological challenges of the future.

*Topics:* Physical, mechanical, and chemical fundamental properties; structure, microstructure/property relations; nanostructured hard materials and surfaces; composites; surface modification technology; tribology of hard materials; corrosion and hot corrosion of hard materials; new experimental methods of study; new processes and applications; and technical innovations.

**Contact:** Prof. Dr. H.G. Sockel, Univ. of Erlangen-Nurnberg, Institute WW I, Martensstr. 5, D-91058 Erlangen, F.R. Germany; e-mail: sockel@www.uni-erlangen.de.

### *Nonstoichiometric Ceramics and Intermetallics*

Kona, Hawaii, 26 April-1 May 1998.

It has been almost ten years since there was an international conference devoted to nonstoichiometry effects in ceramics. Nonstoichiometry controls electrical, diffusional, and many mechanical properties. Therefore, it is a very important property. Perovskite-structured oxides are finding many modern applications as, for example, fuel cell electrodes and high-temperature superconductors. The ionic conductivity and superconducting transition temperatures, respectively, are very sensitive to the deviation from stoichiometry. The recent discovery of the giant magnetoresistance in perovskites opens up further device possibilities. Intermetallics that are also nonstoichiometric compounds are finding much wider-spread applications as structural materials. There are many similarities between nonstoichiometric effects in intermetallics and ceramics, and it will be the goal of this conference to bring scientists from both disciplines together for the first time to learn from each other, determine the common themes and state-of-the-art, and to plan future conferences.

**Contact:** Dr. Jules L. Routbort, Argonne National Laboratory; tel: 630/252-5065; fax: 630/252-4798; Prof. Rudiger Dieckmann, Cornell University; tel: 607/255-4315; fax: 607/255-2365; Prof. Thomas Mason, Northwestern University; tel: 847/491-3198; fax: 847/491-7820; or Engineering Foundation, 345 East 47th St., New York, NY 10017; tel: 212/705-7836; fax: 212/705-7441; WWW: http://www.engfnd.org.

### *NANO'98*

NANO'98, Stockholm, Sweden, 14-19 June 1998.

**Contact:** NANO'98, c/o Royal Institute of Technology, S-100 44 Stockholm, Sweden; tel and fax: +46 8 790 9O 72.

### *PacRim3*

Hotel Hyundai, Kyongji, Korea, 20-23 Sept 1998.

**Contact:** Professor Sang-Hee Cho, Secretary General, Pac Rim 3, Dept. of Inorganic Materials Engineering, Kyungpook National University, Taegu 702-701, Korea.

## Recent Conferences

### *Thermal Barrier Coatings Workshop*

The 1997 TBC Workshop was held in Cincinnati, OH, from 19-21 May. This conference was sponsored by the TBC Interagency Coordination Committee, and the papers that were presented are listed below.

**Heat Transfer/Conductivity**

- "Thermal Conductivity of Thermal Barrier Coatings," P. Klemens and M. Gell, University of Connecticut.
- "Analysis of Thermal Radiation Effects on Temperatures in Turbine Engine Thermal Barrier Coatings," R. Siegel and C. Spuckler, NASA Lewis Research Center.
- "Thermal Conductivity Determinations of Thermal Barrier Coatings," R. Taylor, Thermophysical Properties Research Laboratory (TPRL, Inc.).
- "Thermal Conductivity of Functionally Graded Thermal Barrier Coatings," A. Slifka, B. Filla, and J. Phelps, NIST.
- "Development of Low Thermal Conductivity Thermal Barrier Coatings," M. Maloney, H. Achter and B. Barkalow, Pratt & Whitney.

**Failure Mechanisms**

- "Degradation Modes of Thermal Barrier Coatings: Experience in High Thrust Experimental Engines at Pratt & Whitney," S. Bose and J. Marcin, Pratt & Whitney.
- "Mechanism-Based Life Prediction Issues for Thermal Barrier Coatings," A. Evans, J. Wang, and D. Mum, Harvard University.
- "Modeling Oxidation Induced Stresses in Thermal Barrier Coatings," A. Freborg, B. Ferguson, and G. Petrus, DCT, Inc., and W. Brindley, NASA Lewis Research Center.
- "Influence of Cyclic Strain on PAD TBC Life," P. Wright, GE Aircraft Engines.
- "Industrial Environment-Hot Corrosion-TBC-Interactions," N. Bornstein and W. Allen, UTRC; and M. Trubeljia and D. Nissley, Pratt & Whitney Aircraft Company.
- "The Effect of Alumina Phase Transformations on Thermal Barrier Coating Durability," J. Schaeffer, GE Aircraft Engines.
- "Substrate and Bond Coat Compositions: Factors Affecting Alumina Scale Adhesion," B. Pint, I. Wright, W. Lee, Y. Zhang, K. Prüßner, and K. Alexander, Oak Ridge National Laboratory.

**Characterization/Test Methods**

- "Developing NDE Methods for Coated Combustion Turbine Components," P. Zombo, Westinghouse Electric Company.
- "Investigation of Thermal High Cycle and Low Cycle Fatigue Mechanisms of Thick Thermal Barrier Coatings," D. Zhu and R. Miller, NASA Lewis Research Center.
- "Intelligent Processing of Materials for Thermal Barrier Coatings," Y. Lau, C. Johnson, D. Gray, P. Houpt, M. Penney, and H. Wang, GE Corporate Research and Development.
- "Dynamic Model for Simulation of Heat Transfer, Vaporization, Vapor Transport, and Deposition in EB-PVD Process," F. Azad, GE Corporate Research and Development.

**Posters**

- "Scandia, Yttria-Stabilized Zirconia (SYSZ): Candidate Materials For High Temperature TBCs," R.L. Jones, Naval Research Laboratory.
- "Low Thermal Conductivity in Garnet Ceramics, and Their Possible New Use as Advanced Thermal Barrier Coatings," N.P. Padture, P.G. Klemens, and M. Gell, University of Connecticut.
- "SPPS for Advanced Thermal Barrier Coatings," K.T. Faber, D.E. Boss, T.F. Bernecki, J. Mawdsley, and J. Su, Northwestern University.
- "Low Coefficient of Thermal Expansion Bond Coats for TBCs," D.R. Arenas, W.J. Brindley, L.B. Temples, and D.A. Koss.
- "Relationship between Deposition Conditions and Texture of EB-PVD Thermal Barrier Coatings," U. Schulz and M. Peters, DLR German Aerospace Research Establishment.
- "The Effect on Microstructure on the Creep Response of Functionally Graded Thermal Barrier Coatings," S.M. Arnold, M.-J. Pindera, and J. Aboudi.
- "Residual Stress Measurements in Thermal Barrier Coatings," T.R. Watkins and C.R. Hubbard, Oak Ridge National Laboratory.
- "Effect of Powder Size and Deposition Temperature on the Microstructure and Properties of Plasma Sprayed Zirconia," S. Sampath, J. Matijicek, C.C. Berndt, H. Herman, A. Vardelle, A.C. Leger, M. Vardelle, P. Fauchais, J. Ilavsky, G.G. Long, and S. Dapkunas.
- "Microstructural Characterization of Interfacial $Al_2O_3$ Scales Formed by Cyclic Oxidation of Plasma Sprayed TBCs at 1150 °C," J.A. Haynes, M.K. Ferber, and E.D. Rigney.
- "Residual Stress Development in Thermal Barrier Coatings," R.T.R. McGrann, E.F. Rybicki, J.R. Shadley, J. Wigren, L. Pejryd, and W.J. Brindley.
- "Pore and Crack Structure Evolution in Thermal Barrier Coatings During Processing," A.J. Allen, G.G. Long, and J. Ilavsky.
- "On the Solid Particle Erosion Behavior of Plasma Sprayed and Thermally Cycled Zirconia Coatings," J. Gutlebar, S. Usmani, and S. Sampath, State University of New York.
- "Processing and Characterization Issues Associated with the Synthesis of Low-Sulfur NiAl and NiPtAl Bond Coats," W.Y. Lee, Y. Zhang, I.G. Wright, K.M. Cooley, and P.K. Liaw.
- "Monitoring Damage Evolution in EB-PVD TBCs using Thermal Wave Imaging," S.Q. Nusier, T. Ahmed, Z.A. Chaudhury, R.L. Thomas, and G.M. Newaz, Wayne State University.
- "Thermal Transport Properties and Infrared Imaging of Thermal Barrier Coatings," R.B. Dinwiddie and H. Wang, Oak Ridge National Laboratory.

- "A Thermal Gradient Test System for Thermal Barrier Coatings," G.R. Romanoski, Oak Ridge National Laboratory.
- "Elastic Optical Scatter Methods for Nondestructive Inspection of TBCs," A. Ellingson, J. G. Sun, R. Orenstein, and J. Viertl.
- "Piezo-Spectroscopic Characterization of Thermal Barrier Coatings," M.J. Lance, J.A. Haynes, M.K. Ferber, and W.R. Cannon.
- "Catalytic Combustion Effects in Insulated IC Engines," R.L. Jones, Naval Research Laboratory
- "Assessment of Thermal Conductivity of Thermal Barrier Coatings Made by Plasma Spray Deposition," K.S. Ravichandran, K. An, and R.E. Taylor.
- "Radiation Heat Transfer Procedure for Materials with Different Indices of Refraction," J.C. Chai and J.P. Moder.
- "Improved Powders for the Production of High Temperature Stressed Plasma Sprayed Coatings," H. Meinhardt and H. Keller, H.C. Starck GmbH & Company.

## *American Welding Society Meeting*

The AWS meeting was held in Los Angeles from 13-17 April, and the following thermal spray activities were included in the program.

### *Short Course on Thermal Spray*

A course on "Introduction to Thermal Spray: Processes, Coatings, and Applications," sponsored by the American Welding Society and the ASM Thermal Spray Society. This short course included a brief review of major advanced thermal spray processes, a description of the more commonly used coatings, and selection of coating processes and materials. Instructors for this seminar were Douglas H. Harris, President and Cofounder of APS-Materials, Inc., and Robert C. Tucker, Jr., Ph.D., a Corporate Fellow and Director of Strategic R&D at Praxair Surface Technologies, Inc., and President of the Thermal Spray Society of ASM International. The course objective was to provide an introduction to thermal spray to those unfamiliar with the field or who need an update. Topics included: Thermal Spray Processes, Coating Structures and Properties, and Applications.

### *6th AWS Thermal Spray Symposium*

**Infrastructure**

- "Selection of Thermal Spray Coatings for Protection of Steel," R.A. Sulit, Sulit Engineering.
- "High Output Arc System Application Costs," E.R. Sampson, TAFA, Inc.; and R.A. Sulit, Digital Systems Research, Inc.
- "Corrosion Protection of Reinforcing Steel in Concrete Using Thermal Sprayed Anodes," E. Costa, Corrosion Restoration Technologies, Inc.

**High-Velocity Oxyfuel (HVOF) and Plasma**

- "Realities of High-Velocity Oxyfuel (HVOF) Thermal Spraying," J.A. Browning, Draco Technologies.
- "The Advantages of Thermal Spray Coatings as a Replacement to Hard Chrome Plating," M. Schroeder and R.H. Anger, TAFA Inc.
- "Structure and Properties of High-Velocity Oxyfuel and High Energy Plasma Sprayed WC/Co Coatings," M. Mohanty and M. Doffman, Sulzer Metco (U.S.), Inc.
- "High-Velocity Oxyfuel (HVOF) and Plasma Spraying of Duplex Stainless Steel Pumps," I.D. Harris, EWI.
- "Plasma Spraying Metal-Ceramic Coatings for Thermal Barrier Coatings (TBC) Applications," C.R.C. Lima, Methodist University of Piracicaba, Brazil; and R.E. Trevisan, State University of Campinas, Brazil.

**Testing and Materials**

- "Wear Coatings for Carrier Aircraft Hookpoints," L. Moskowitz, Naval Air Warfare Center.
- "Residual Stresses and the Fatigue Performance of High-Velocity Oxyfuel (HVOF) Tungsten Carbide Thermal Spray Coatings," D. Greving, J.R. Shadley, and E.F. Rybicki, University of Tulsa, and D. Sommerville, Southwest Aeroservice.
- "Effect of Powder Injection Methods on High Energy Plasma Coating Characteristics," S. LaCourse, TAFA Inc.; and H. Jungklaus, Technical University of Aachen, Germany.
- "High Throughput Processing of Thick Coatings Using Water Stabilized Plasma," R.V Gansert, Hardface Alloys, Inc.; K. Dobler, S. Sampath, C.C. Berndt, and H. Herman, State University of New York at Stony Brook; and P. Chraska, Institute of Plasma Physics, Czech Republic.

**List of Thermal Spray Exhibitors at the AWS Meeting**

- AGA Gas, Inc.
- American Torch Tip Company

- BTU Contracts, Inc.
- ESAB Welding & Cutting Products
- International Thermal Spray Association
- Inweld Corporation
- Motoman Inc.
- Praxair Thermal Spray Systems
- Rankin Industries, Inc.
- Stellite Coatings
- Sulzer Metco
- TAFA Inc.
- Thermadyne Industries
- Vautid USA c/o Vautid-Verschleiss-Technik
- Wall Colmonoy Corporation

### *Intelligent Processing of Materials*

The Industrial Workshop titled "Intelligent Processing of Materials for Thermal Spraying" was held at the GE Research & Development Center on 12 June 1997 at Niskayuna, NY. This meeting was sponsored by the Physical Metallurgy Laboratory of GE Corporate R&D, and the following papers were presented.

- "Thermal Spray Equipment," S. O'Keefe, Sulzer Metco.
- "IPM for Applications in Landbased Gas Turbines," C. Furstoss, GE Power Systems.
- "Sensor Research and Development," C. Moreau, National Research Council of Canada.
- "IPM for Thermal Spray Applications," D. Crawmer, Praxair Surface Technologies, Inc.
- "IPM for Thermal Spray Applications," G. Kutner, Englehard Surface Technologies.
- "Control Strategy for IPM for Thermal Barrier Coatings."
- "Sensor Development and Qualification for IPM of Thermal Barrier Coatings."
- "Plasma Modeling."
- "Modeling and Experimental Study of Particle Impact During Plasma Spray."
- "Hardening of Sensors."
- "Accurate Measurements with Sensors."
- "New Gun Technology."