

PII: S0017-9310(96)00338-9

BOOK REVIEW

ANNIE STEINCHEN (ed.), **Dynamics of Multiphase Flows across Interfaces**, Lecture Notes in Physics series (Vol. 467) published by Springer-Verlag, Berlin, 1996; ISBN 3-540-60848-6; US\$ 73, 267 pp.

Just a few years ago, the then European Community established Human Capital and Mobility Network grants to integrate some research across European institutions. In the case of fundamental research in the sciences, this approach has worked well in knitting together the network partners. In order to have such team working, the number of research groups must be small, and this necessarily limits the dissemination of preliminary results. In order to achieve wider exposure, the "Dynamics of Multiphase Flows across Interfaces" network organized a meeting and a workshop with a wider audience than just the network. Selected articles were commissioned from the participants to form this collected volume, demonstrating the good work and new ideas generated by the network on their four themes:

- (1) fundamental constitutive equations for surfaces;
- (2) surface instabilities;
- (3) boiling, evaporation, condensation;
- (4) surfaces in external fields.

Where the network approach is especially successful is in multidisciplinary contributions to joint projects, the authors vary from theorists to experimentalists from physics, physical chemistry and chemical engineering. The quality of the individual contributions is uniformly excellent and this will be elaborated on throughout this review. At this point it is appropriate to consider to whom and for which purpose the book will be most useful.

Obviously, to researchers in the field of interfacial transport, this is an intriguing collection. The fundamental articles on constitutive equations review the treatment of the interface by effect surface transport properties on the macroscopic scale by treating the contributions of microscopic processes by various approaches (statistical mechanics, rational mechanics, thermodynamics and hydrodynamics). Modellers seeking to simplify the interfacial transport dynamics by introducing constitutive equations would be well served by reading the first nine articles, especially those by Prud'homme, Gouin and Sanfeld and Steichen. There are several pitfalls in the asymptotic treatment of interfacial dynamics by curved surfaces which manifest only in the interfacial transport. These articles form an excellent core for a lecture or lectures on this topic at the graduate level for students of transport phenomena.

Given the plethora of applications for free convection processes (building design, electronic devices, solar collectors, thermal storage devices, cooling systems, geophysics, etc.) the articles on Maragoni-Benard convection, albeit largely concerned with the Maragoni effects, should generate substantial interest. Simon gives a beautiful exposition of evaporation driven convective phenomena that leads to random thermosolutal pattern formation in unbounded media, but eventually to organization suppressing randomness as patterns influenced by horizontal boundaries propagate internally. Ceriser and Rahal contribute an article on the

observed effects on thermal convection due to inclination of the enclosure. Ceriser and Lebon made an experimental study of surface defection in thin layers of the Maragoni-Benard problem, augmented by linear theory for surface defection. These papers, however, are not an especially good starting point for students of the subject, but rather intriguing specialist works.

The two papers on boiling especially caught my eye as one of the undergraduate laboratory projects I supervise uses a dedicated unit to infer heat transfer coefficients in different boiling regimes. It targets finding the critical heat flux for the nucleate to film boiling transition under terrestrial conditions. The best undergraduate references and reading to understand these mechanisms and the Zuber model is from the 1950s. Although Straub *et al.* and Sefiane and Steichen in this volume focus on boiling mechanisms under microgravity, which are spectacularly different, their exposition of the fundamentals of terrestrial boiling modes is both concise and complete. I will be recommending it as reading to my students for this reason.

In the final section of the book dealing with surfaces under external fields, the articles seemed to appeal only to specialists. Nonetheless, Liggieri *et al.* explain a new tool for interfacial tension measurement via capillary pressure measurements that should find wide use, given the cheapness of piezoelectric pressure transducers. A most intriguing review is also given by Velarde of the ground-breaking works of Professor John Ross (a Stanford chemist) and some of their joint applications to physicochemical hydrodynamics of a new theory of nonlinear nonequilibrium thermodynamics based on the concept of excess work. Gibbs' treatment of equilibrium was based on the concept of excess free energy deviation from equilibrium. The analogous treatment of nonequilibrium thermodynamics is the excess work deviation from a nonequilibrium stationary state. Ross has treated chemical nonequilibrium stationary states in this fashion. Their joint works extend the concept to simple transport processes (conduction and Couette-Poiseuille flow) and to the Lorenz equations of supercritical thermal convection. The problem of extending the theory to more general transport phenomena, specifically the inaptness of the Navier-Stokes equations, is highlighted. This reader suspects that the lack of thermodynamics in the Navier-Stokes formulation can only be remedied by the nonequilibrium thermodynamics extension of the gasdynamics equations. Alas, such a problem is well suited to the genius of the late Zeldovich!

In summary, the scientific community has been well served by the dissemination of the work of the Human Capital and Mobility network ERB CHRCX-CT-94 940481 on the "Dynamics of Multiphase Flows across Interfaces". Many of the readers of the International Journal of Heat and Mass Transfer will find similar uses for this volume as a reference to those that I have mentioned above. It is a like a box of assorted chocolates, something to the taste of everyone.

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