Editorial

The development of alloys into useful and practical materials remains a major scientific and engineering challenge. On the science front, there is a clear need to develop a fundamental understanding of the factors controlling, for example, stability, strength, ductility, and toughness, as well as magnetic, electrical, and transport properties for a bewildering number of binary and multicomponent alloys. In fact, as we continue to accumulate empirical knowledge, it becomes increasingly clear that fundamental understanding is crucial if we ever hope to establish rational and intelligent strategies for materials development and design. On the engineering front, novel processing and manufacturing methodologies must be found.

During the last five years or so, we have seen a flurry of activity in the characterization, synthesis, and modeling of nano-sized materials. Phase relations in these systems are poorly understood. Thus, to current practitioners of the art and science of phase stability, the realm of the nanoscale offers excellent opportunities and fertile ground for research. After all, phase equilibrium and phase relations in the materials world can invariably be brought to bear on the optimization of properties, a fact that our community readily recognized.

The last 10 years or so have also seen impressive advances in the development of new tools and concepts in the study of phase equilibria. Among these are the characterization of elastic effects in phase equilibrium and the study of the thermodynamic properties of surfaces, interfaces, multilayers, and a variety of other nano-sized structures. During the same period we have seen significant progress toward a first-principles thermodynamics theory in which quantum mechanics plays, as it should, a central role. The emerging field of nanoscience and the need to understand and predict materials properties in this new and essentially unexplored territory is a powerful incentive to develop a mature, robust, and practical ab-initio theory of phase equilibria.

As a journal dedicated to phase equilibria, we are faced with the exciting prospect of also providing a venue to those interested in bridging the gap between the macroscopic world of thermodynamics and the microscopic domain of quantum physics.

Juan M. Sanchez
Associate Editor
Journal of Phase Equilibria

Statement of Ownership, Management, and Circulation

Publication Title: *Journal of Phase Equlibria*; No.: 588110; Filing Date: *30 September 2003*; Issue Frequency: *Bimonthly*; No. of Issues Published Annually: *6*; Annual Subscription Price: *Multi-user/Non-Member $1513, Individual Member $226*; Complete Mailing Address of Known Office of Publication: *ASM International, Materials Park, Geauga County, OH 44073-0002*; Contact Person: *Mary Anne Fleming*; Telephone: *440/338-5151*; Complete Mailing Address of Headquarters or General Business Office of Publisher: *ASM International, Materials Park, OH 44073-0002*; Publisher: *ASM International, Materials Park, OH 44073-0002, USA*; Editor: *Jack F. Smith, Ames Laboratory, Iowa State University, Ames, IA 50011, USA*; Managing Editor: *Mary Anne Fleming, ASM International, Materials Park, OH 44073-0002, USA*; Owner: *ASM International, Materials Park, OH 44073-0002 USA*; Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities: *None*; The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purpose has not changed during the preceding 12 months; Issue Date for Circulation Data Below: *August 2003*.

Extent and Nature of Circulation	Average No. Copies Each Issue During Preceding 12 Months	Average No. Copies of Single Issue Published Nearest to Filing Date
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The Statement of Ownership will be printed in the October 2003 issue of this publication.

Mary Anne Fleming

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