FINAL TECHNICAL REPORT
THIRD SIAM CONFERENCE ON
MATHEMATICAL ASPECTS OF MATERIALS SCIENCE

MAY 22-24, 2000, PHILADELPHIA, PA

The Third SIAM conference on Mathematical Aspects of Materials Science took place in Philadelphia, May 22-24, 2000.

This meeting gathered the interdisciplinary community of scientists working on mathematical and computational aspects of materials science. One goal was to examine recent methodological advances in areas such as:

- o Analysis of moving interfaces
- o Macroscopic consequences of microstructure
- o Defects in materials

A second goal was to highlight recent accomplishments in areas such as:

- o Materials design, synthesis and processing
- o Simulation of phase transformation dynamics
- o Growth and morphology of thin films
- o Electromagnetic materials

A third goal was to identify promising directions for new developments of a mathematical or computational nature, in areas such as:

- o Multiscale analysis of materials; from atomic to continuum
- o Nanoscale structures
- o Liquid crystals, glasses and polymers
- o Soft materials and bio-materials

All these goals were achieved. The meeting drew 270 registered participants from a broad range of backgrounds, including mechanics, physics, metallurgy, mathematics, and computer science. Approximately 1/5 of the registered participants were people who came to listen, or to speak. Many were students or recent Ph.D.'s. A considerable number were scientists from government and industrial labs. The program included 11 Plenary Lectures, 42 Minisymposia sessions (four or five speakers each), and about 22 Contributed Paper Sessions (three or four speakers each).

This SIAM meeting filled a number of pressing needs. It gathered a large part of the SIAM community working on problems from materials science, rather than just a narrow segment, thus creating a sense of community. It highlighted problems amenable to mathematical or computational progress in the near future. And it was relatively accessible to students, postdocs, and non-specialists interested in becoming more active in this area.

PLENARY LECTURES

The organizing committee made a conscious effort toward breadth in the selection of Plenary Speakers.

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Five were from departments of physics or engineering science (Davis, Marder, Miksis, Phillips, Zangwill), and six were from departments of mathematics (Golden, Bertozzi, Caflisch, Lowengrub, Chapman, Otto). Here is the full list of plenary speakers and titles:

- S. Jonathan Chapman, Oxford University, United Kingdom
"From Dislocations to Plasticity: The Role of Matched Asymptotic Expansions"
- Kenneth M. Golden, University of Utah
"Mathematics of Sea Ice"
- Andrea L. Bertozzi, Duke University
"Undercompressive Shocks in Coating Flows"
- Andrew Zangwill, Georgia Institute of Technology
"Continuum Models of Epitaxial Growth"
- Russel E. Caflisch, University of California, Los Angeles
"Modeling, Simulation and Control for Epitaxial Growth of Thin Films"
- Michael J. Miksis, Northwestern University
"Surface Diffusion Effects on the Stability of Rods and Films"
- John Lowengrub, University of Minnesota and University of North Carolina
"Microstructure Evolution in Inhomogeneous Elastic Media"
- Stephen H. Davis, Northwestern University
"Anisotropic Crystal Growth"
- Robert Phillips, Brown University
"Crystals, Defects and Microstructures: The Case for Multiscale Modeling"
- Michael P. Marder, University of Texas, Austin
"Atomic Effects in Brittle Fracture"
- Felix Otto, University of Bonn, Germany
"Predicting Magnetization Pattern"

MINISYMPOSIA

The organizing committee sought a balance between novelty and tradition in selecting the Minisymposia. The conference was, first and foremost, a gathering of the vibrant and interdisciplinary community of scientists studying mathematical and computational aspects of materials science. Therefore, many minisymposia showcased recent progress achieved by subgroups of this community, including:

- o Modeling of epitaxial growth of crystalline films, including Monte Carlo simulations, step flow laws, and surface evolution laws.

- o Numerical methods for continuum models of materials, with applications to composite materials, shape-memory alloys, liquid crystal semiconductors, and magnetic materials.
- o New computational and analytical tools for optimal design, structural optimization, and shape optimization.
- o A deepened understanding of superconductivity, through Landau-Ginsburg models and macroscopic models for the distribution of current in the material.
- o New models and insight on liquid crystals, including continuum models for equilibrium, defects, phase transitions, and flow phenomena.

We also sought to enlarge the SIAM community's scientific scope by soliciting minisymposia in areas we felt were ripe for more attention by applied mathematicians.

Examples included:

- o Multiscale analysis of materials; from atomic to continuum
- o Nanoscale structures
- o Glasses and polymers
- o Soft materials and bio-materials

The full list of minisymposia follows:

- o Instabilities and Breakdown of Asymptotic Models in Continuum Mechanics
- o Computational Problems in Materials Science - (in 4 sessions)
- o Mathematical and Computational Issues of Modelling Functionally Graded Materials
- o Domain Coarsening Dynamics - (in 2 sessions)
- o Computations and Analysis of Interfaces in Materials - (in 2 sessions)
- o Liquid Crystals: Mathematical and Numerical Aspects - (in 2 sessions)
- o Macroscopic Properties of Heterogeneous Material Systems
- o Epitaxial Growth - (in 4 sessions)
- o Multiscale Approaches for the Evolution of Microstructure in Solidification Processes
- o Ordering and Phase Separation
- o Industrial Problems Involving Multiscale Phenomena
- o Analytic and Experimental Characterization of Piezoelectric Materials - (in 2 sessions)
- o Role of Curvature and Hydrodynamics in Soft and Biological Matter - (in 2 sessions)
- o Four Monologues in Sintering
- o The Dynamics of Phase Transitions - (in 3 sessions)
- o Polymer-Liquid Crystal Systems - (in 3 sessions)
- o Models, Analysis and Computations for Superconducting Materials - (in 3 sessions)
- o Optimal Design of Structures and Microstructures - (in 2 sessions)
- o Elastic Compatibility and Phase Transitions: 3D and General Boundary Conditions - (in 2 sessions)
- o Advanced Applications of Density Functional Theory in Materials Science
- o Magnetic Materials
- o Dynamics of Transport in Liquid Films

ORGANIZING COMMITTEE

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