Deformation Mechanisms, Microstructure Evolution and Mechanical Properties of Nanoscale Materials

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PREFACE

Symposium P, "Deformation Mechanisms, Microstructure Evolution, and Mechanical Properties of Nanoscale Materials," was held Nov. 29–Dec. 3 at the 2010 MRS Fall Meeting in Boston, Massachusetts. This resultant volume addresses the topic of materials used in next-generation technological devices. These devices are used for a variety of applications—ranging from biomedical to space to energy-related—and will be subjected to non-ambient temperatures and high stresses and pressures. A variety of advanced nanomaterials and nanoscaled architectures have been proposed to meet these stringent demands. However, a complete understanding of the mechanisms that govern deformation at these scales is still elusive. Accelerated use and integration of nanomaterials can be enabled by the complementary combination of atomistic and multiscale simulations with integrated in situ instrumentation and techniques, where synthesis, testing, environmental control, and direct imaging occur simultaneously.

This volume focuses on providing the state-of-the-art research on the mechanical response of nano- and microscale components that may comprise these devices, such as nanopillars, nanotubes, nanowires, nanolayers, ultra-thin films, nanoparticles, and nanocrystalline and nanotwinned materials. These mechanical properties are discussed in the context of their unique microstructures and their evolution, shedding light on the effects of size in critical dimensions on the mechanical strength and deformation mechanisms. Particular importance is assigned to understanding the role of defects and flaws in these small volumes, as their energetics and interactions elicit the observed mechanical response. This volume highlights emerging topics in novel mechanical testing techniques, in situ microscopy, high- and low-temperature deformation mechanisms, and mechanical property characterization of materials, as well as recent advances in atomistic and multiscale modeling of nanomaterials. A partial list of specific topics comprising this volume includes:

- Experiments and modeling on deformation behavior of nanoscale materials
- Mechanics of nanocomposites and heterostructures
- Hybrid organic/inorganic nanomaterials
- Mechanics of ultra-strong materials
- Investigations and engineering of interfaces in nanomaterials for enhanced stability
- Microstructural characterization of defect evolution in nano- and microscale volumes
- Temperature and time-dependent mechanical response
- Fracture, fatigue, and degradation mechanisms in nanomaterials
- Advancements in ex situ and in situ small scale characterization methods
- Coupled mechanical behavior of nanomaterials (e.g. electromechanics, chemomechanics)
- Materials by design simulation and modeling approaches
- Atomistic and multiscale simulation of mechanical behavior of nanomaterials

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