Carnegie Mellon
Materials Science and Engineering Seminar Series

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Mechanical and Materials Science and Engineering
John Hopkins University

"Uncovering the Mechanical Behavior of Materials for MEMS and Nanocrystalline Metals"

Friday, January 22, 2010
11:30 A.M. Seminar in Scaife Hall 125

Micro-tensile testing and TEM have been employed to characterize the small-scale and scale-specific mechanical behavior of materials for MEMS and nanocrystalline thin films. MEMS structures are often deposited far from microstructural equilibrium and the mechanical properties of these materials will be shown to be strongly processing, microstructure and temperature dependent. The extremely high hardness and strength of nanocrystalline materials have been well-documented, but operative deformation mechanisms in these materials have proven to be much harder to quantify. Experimental observations of twinning and grain growth in nc-Al will be used to underscore the novel deformation mechanisms operative in nanocrystalline metals. Of particular interest is the extended plasticity that occurs as a result of stress-induced discontinuous grain growth. Efforts to model this growth with traditional driving forces have proven less than satisfactory, and the importance of grain boundary pinning and the role of stress assisted grain boundary migration appear to be more important. The significance of this finding with respect to the reliability of thin film nanocrystalline devices cannot be ignored, as the mechanical behavior of these structures appears to not only be different than that of microcrystalline metals but dynamic as well.

Kevin Hemker is Professor and Chair of the Department of Mechanical Engineering at Johns Hopkins University and holds joint appointments in the Departments of Materials Science & Engineering and Earth & Planetary Sciences. He holds a BS in metallurgy from the University of Cincinnati, MS and PhD degrees in materials science and engineering from Stanford University, and completed a post doctoral fellowship at the Ecole Polytechnique Federale de Lausanne. He was an NSF National Young Investigator, an invited Professor at the EPFL (1995) and the University of Paris XIII (2001), and received the ASM Materials Science Research Silver Medal in 2001. His group is engaged in research on: the identification of processing-microstructure-property relations in materials for MEMS, characterization and modeling of thermal barrier coatings, deformation of nanocrystalline metals, and HREM characterization of dislocation core structures. He has authored or co-authored over 150 journal articles and proceedings, co-edited 4 books, presented numerous invited and plenary lectures, and is an editor of *Scripta Materialia* and a Fellow of the American Society of Mechanical Engineers (ASME) and ASM International.