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Title:

INVESTIGATIONS OF THE MECHANICAL PROPERTIES OF NANOSTRUCTURED MATERIALS WITHIN THE CENTER FOR INTEGRATED NANOTECHNOLOGIES

Author(s):

Amit Misra (MST-8)
J. Charles Barbour (SNL-Albuquerque)
David M. Follstaedt (SNL-Albuquerque)
Harriet Kung (MST-8)
T.A. Friedman (SNL-Albuquerque)
J.P. Sullivan (SNL-Albuquerque)

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INVESTIGATIONS OF THE MECHANICAL PROPERTIES OF NANOSTRUCTURED MATERIALS WITHIN THE CENTER FOR INTEGRATED NANOTECHNOLOGIES

J.C. Barbour[1], A. Misra[2], D.M. Follstaedt[1], H. Kung[2,3], T.A. Friedmann[1], and J.P. Sullivan[1]
[1]Sandia National Laboratories, Albuquerque, NM 87185, USA
[2]Los Alamos National Laboratory, Los Alamos, NM 87545 USA
[3]Present address: Division of Materials Sciences and Engineering, Office of Basic Energy Sciences, Germantown, MD 20874 USA

Future technologies will rely on a complex integration of materials and functionality that bridge several length scales to connect nanoscale architectures to the real world of man. An important aspect of this vision will be the ability to produce mechanical work at the nanoscale and the transduction of energy from nano- to microscale systems. These systems are inherently made of nanostructured materials and therefore it is essential to understand the mechanisms and limits of mechanical deformation and stability of these materials. In addition it is important to understand the mechanical properties that haveafforded nanoscale devices because of the small size scale. At this size, interfacial area becomes a significant portion of any material and the mechanical properties which are uniquely a result of these interfaces may then dominate the mechanical properties of the system. This talk will give an overview of the development of new materials to achieve novel mechanical properties based upon tailored nanostructures and discuss the current understanding of the mechanisms that govern their mechanical response. Our institutions have examined the ability to tailor nanostructures for testing the limits of classical strengthening and toughening mechanisms, such as in nano-dispersion strengthening of metals, and grain-size strengthening of metals and metal multi-layered composites. We have found grain-size strengthening in a homogeneous Ni sample follows the classical behavior down to ~10 nm in size, while the strength drops in layered metals below layer thickness of ~5 nm for miscible systems such as Cu-Ni and below ~1 nm for immisicible systems such as Cu-Nb. Also, we have investigated the effect of variation in density and bonding on the mechanical properties of amorphous alumina and tetrahedrally-bonded carbon, and the mechanisms of energy dissipation in small-scale structures.
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Invited Talk