Mechanical and Aerospace Engineering

Distinguished Scholar Lecture

F E A T U R I N G

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"Nanostructured Metals and Composites: From the Nanoscale to the Microscale"

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ABSTRACT

Three dimensional, bulk nanostructured materials and composites have matured into a new class of materials that is being considered in a variety of engineering applications. The successful synthesis of large-scale nanostructured materials is of technological and scientific significance. From a technological point of view, it will be feasible to obtain engineering materials that retain the structural and chemical attributes of particles/grains in the nanometer size range. From scientific point of view, large-scale nanostructured materials will permit systematic investigations of the physical and mechanical behavior, as well as novel phenomena.

Recently, severe plastic deformation (SPD), which encompasses mechanical alloying in liquid nitrogen (cryomilling) and high-pressure torsion, has emerged as a successful strategy for the synthesis of nanostructured alloys and composites. Results from various groups around the world reveal considerable improvements in the physical performance of a variety of SPD processed metals and alloys. While increases in strength of several 100% are commonly documented, ductility, however, appears to scale inversely with strength in these materials; this behavior has been attributed to limited dislocation activity at these length scales. This challenge has been addressed via the introduction of additional size scales that facilitate plasticity during deformation. The concept of a bimodal microstructure has recently been extended into the realm of metal composites with tri-modal microstructural characteristics, to accomplish ultra-high strength values. In this lecture, published data of cryomilled alloys and composites are reviewed and discussed with particular emphasis on the following topics: recent findings in the area of cryomilled materials; primary consolidation and secondary processing methods; microstructural evolution from nanostructured powders to bulk materials during consolidation; and mechanical behavior of consolidated materials. The deformation behavior and the underlying mechanisms of cryomilled materials are discussed in an effort to shed light into the fundamental behavior of ultrafine grained and nanostructured materials.

BIOSKETCH

Enrique Lavernia returned to his post as dean of the College of Engineering, a position he previously held from 2002 to 2009, after serving as the provost and executive vice chancellor of the University of California, Davis, from January 2009 to December 2010. Prior to arriving at Davis, Lavernia served as chair and chancellor's professor in the Department of Chemical Engineering and Materials Science at UC Irvine. Dr. Lavernia holds a faculty appointment within the Department of Chemical Engineering and Materials Science at UC Davis., where he was promoted to Distinguished Professor in 2007. His research interests include the synthesis and behavior of Nanostructured and multi-scale materials with particular emphasis on processing fundamentals and physical behavior; thermal spray processing of nanostructures materials, spray atomization and the deposition of structural materials, high temperature-high pressure atomization processes and mathematical modeling of advance materials and processes. He has published 500 journal and 200 conference publications on topics ranging from nanomaterial to extremely strong aluminum alloys. Lavernia earned his B.D. with Honors in Solid Mechanic from Brown University and His M.S. in Metallurgy and Ph.D. in Material Engineering broth the Massachusetts Institute of Technology.

Reception to follow in Portico of ISTB 1

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