DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS

The 2015 DCAMM Annual Seminar Speaker

Julia R. Greer

Professor
California Institute of Technology
USA

gives the following lecture at

Aalborg University
Auditorium 1.108
Fibigerstræde 16, 9220 Aalborg Øst

Materials by Design: 3-Dimensional Architected Nanostructured Meta-Materials

Monday, September 28, at 13:00

There will be an open discussion after the lecture
at 14:00
(Refreshments are served)

This lecture aims at popularizing mechanical science to a broad audience of interested students and staff as well as engineers working in industry

The Danish Centre for Applied Mathematics and Mechanics, DCAMM, is a framework for internationally oriented scientific collaboration between staff members at a number of departments at the Technical University of Denmark, Aalborg University, Aarhus University and University of Southern Denmark. The "DCAMM Annual Seminar Speaker" is an initiative created to disseminate mechanics to a broader audience. *For further information on DCAMM, see www.dcamm.dk*

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Abstract

Creation of extremely strong yet ultra-light materials can be achieved by capitalizing on the hierarchical design of 3-dimensional nano-architectures. Such structural metamaterials exhibit superior thermomechanical properties at extremely low mass densities (lighter than aerogels), making these solid foams ideal for many scientific and technological applications. The dominant deformation mechanisms in such "meta-materials", where individual constituent size (nanometers to microns) is comparable to the characteristic microstructural length scale of the constituent solid, are essentially unknown. To harness the lucrative properties of 3-dimensional hierachical nanostructures, it is critical to assess mechanical properties at each relevant scale while capturing the overall structural complexity.

We present the fabrication of 3-dimensional nano-lattices whose constituents vary in size from several nanometers to tens of microns to millimeters. We discuss the deformation and mechanical properties of a range of nano-sized solids with different microstructures deformed in an in-situ nanomechanical instrument. Attention is focused on the interplay between the internal critical microstructural length scale of materials and their external limitations in revealing the physical mechanisms which govern the mechanical deformation, where competing material- and structure-induced size effects drive overall properties.

We focus on the deformation and failure in metallic, ceramic, and glassy nano structures and discuss size effects in nanomaterials in the framework of mechanics and physics of defects. Specific discussion topics include: fabrication and characterization of hierarchical 3-dimensional architected meta-materials for applications in biomedical devices, ultra lightweight batteries, damage-tolerant cellular solids, nanomechanical experiments, and flaw sensitivity in fracture of nano structures.

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