THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
WINTER COLLOQUIUM SERIES PRESENTS:

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Mesoscale material mechanics modeling for deformation behaviors in amorphous and nanocrystalline alloys

Materials are, by their very nature, stochastic. Modeling materials across scales requires models that capture this inherent stochasticity. In this talk, I will discuss mesoscale modeling approaches, incorporating the element of stochasticity in coarse-grained models enables collective deformation processes to be modeled in a way that captures their inherent variability and probabilistic nature for two high-strength structural alloys. First, the metallic glasses, also known as amorphous metals are metallic alloys that have no long-range crystalline structure. As a result, their deformation differs significantly from that of crystalline materials, exhibiting glass-like flow at high temperatures and localized deformation, in the form of shear bands, at low temperatures. A mesoscale shear transformation zone dynamics model using a coarse-grained, kinetic Monte Carlo algorithm will be presented to examine the deformation behaviors that span time and length scales. Emphasis will be placed on the influence of nanoscale heterogeneity due to the atomic short-range to medium-range orders on the large-scale shear banding behaviors. Second, we develop a mesoscale quantized crystal plasticity model for nanocrystalline alloys inspired by the variability of atomic structures and strengths at the nanoscale. The model explores the connection between large fluctuation in dislocation slip across nanoscale grains and the collective deformation phenomena in nanocrystalline alloys by implementing quantized dislocation plasticity that evolves from specific probability distribution functions of strength. The model is used to capture several mechanical properties and microstress evolution that are unique to nanocrystalline metals measured by in-situ X-ray diffraction and TEM tests. We envision these mesoscale approaches will fulfill an increasing need as we improve our understanding of quantum and atomistic processes and strive to apply these to complex systems at the continuum scale.

Dr. Lin Li is currently an associate professor in the Department of Metallurgical and Materials Engineering at The University of Alabama. Dr. Li received her B.S. from Zhejiang University in China in 2005, Ph.D. degrees in Materials Science and Engineering from The Ohio State University in 2011. Thereafter, she worked as a postdoctoral associate at the Massachusetts Institute of Technology before joining The University of Alabama in 2013. Her research interest is to explore the structure-property-processing relationships in advanced structural metals and materials, with emphasis on size effect, structural disorder, interfaces, and their roles on material mechanical properties. Her research utilizes computational simulations and analytical tools to establish the connections between microscopic atomic processes and macroscopic material performance, particularly for nanostructured alloys, metallic glasses, and superalloys. Dr. Li is the recipient of the Ralph E. Powe Junior Faculty Enhancement Awards from Oak Ridge Associated Universities.

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Registration is required.

Questions? Contact Kristina.lugo@northwestern.edu.

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