

Thermo/Mechanical Length Scales in Metals from Gradient Plasticity and Molecular Dynamics Studies of Nano-indentation



Strain gradient plasticity (SGP) is used to predict size effects in the deformation behavior of metals at the micron and submicron scale and it is appropriate for problems involving small dimensions. Size dependency of the mechanical properties is a consequence of increase in strain gradients inherent in small localized zones which lead to geometrically necessarily dislocations that cause additional strengthening. The current SGP theories do not give sound interpretations of the size effects if a definite and fixed length scale parameter is used and variable length scale which changes with the deformation of the microstructure that depends on dislocation evolution, temperature, and rate effects in addition to the grain size is required to address the real behavior of the materials. Moreover, the observed indentation size effect cannot be well explained by the SGP theories.

The correlation of the data obtained from MD and SGP simulations of nano-indentation is used to guide the process of identification of characteristic thermo/mechanical length scales in metals. The research studies aim at developing fundamental understanding of critical issues such as: i) the role of characteristic length scales, temperature, and microstructural features (grain size, grain boundaries, texture, etc.) on the yield and flow stresses of nanomaterials, ii) the enabling knowledge of grain boundary engineering aimed at achieving microstructures with desired properties, and iii) advancing the multiscale and physical-based theoretical and computational models to capture the observed mechanical response and scale-dependent characteristics.

George Z. Voyiadjis is the Boyd Professor at the Louisiana State University, in the Department of Civil and Environmental Engineering. Voyiadjis is a Foreign Member of the Polish Academy of Sciences. He is the recipient of the 2008 Nathan M. Newmark Medal of the American Society of Civil Engineers and the 2012 Khan International Medal for outstanding life-long Contribution to the field of Plasticity. Voyiadjis' primary research interest is in plasticity and damage mechanics of metals, metal matrix composites, polymers and ceramics with emphasis on the theoretical modeling, numerical simulation of material behavior, and experimental correlation. Research activities of particular interest encompass macro-mechanical and micro-mechanical constitutive modeling, experimental procedures for quantification of crack densities, inelastic behavior, thermal effects, interfaces, damage, failure, fracture, impact, and numerical modeling.

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JHU Homewood Campus, Hackerman Hall B-17

Seminar is **FREE and open to the public**. Attendance is required for all enrolled Civil Engineering graduate students. For parking please see link for visitors at www.jhu.edu and select information on Homewood Campus. For CISMMS information, visit <http://cismms.jhu.edu>