MAE Seminar Series

Plasticity in Extreme Environments: Recrystallization and Grain Growth

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ABSTRACT

Dynamic recrystallization is defined as a spontaneous change in the microstructure of a material during deformation at an elevated temperature due to the growth of defect-free grains. One of the most important use of recrystallization is in metals processing, where recrystallized grains increase the ductility, resulting in better control of the grain structure. On the other hand, it is undesirable from a design perspective, since recrystallization alters the material's designed macroscopic properties. Understanding the relationship between recrystallization and the macroscopic properties is of fundamental importance for the manufacturing and the design of new materials. Dynamic recrystallization is a uniquely challenging phenomenon to model since the materials microstructure and deformation evolve at the same time scale. Grain boundary (GB) motion in the absence of deformation is commonly modeled using phase field models, while the deformation of a material with a fixed grain boundary structure is commonly modeled using crystal plasticity. In this talk, I will present a thermodynamically-consistent model we recently developed that describes deformation and grain growth simultaneously, thus enabling us to understand dynamic recrystallization within a unified framework. The model is rooted in the framework of polycrystal plasticity with grain boundaries described as geometrically-necessary-dislocations (GNDs). The richness of the model lies in its ability to simulate various GB-mediated plastic phenomena observed in dynamic recrystallization, such as grain rotation, shrinkage and sliding, coupled GB motion, and dynamic polygonization.

BIO SKETCH

Nikhil Admal is a Postdoctoral Research Scholar in the Materials Science and Engineering department at University of California Los Angeles (UCLA). He received his PhD in Aerospace Engineering and Mechanics from the University of Minnesota in 2014. His research interests focus on the development of materials models at various length and times scales ranging from the atomic to the continuum scales. Currently, the focus of his research is on modeling dynamic recrystallization in refractory metals, and development of first-principles strain gradient elastic models to include non-local effects relevant in micromechanical systems. Dr. Admal is a recipient of the Institute for Digital Research and Education (IDRE) Postdoctoral Fellowship at UCLA, and the Doctoral Dissertation Fellowship from the University of Minnesota. Dr. Admal has published in various international journals including The Journal of Chemical Physics, Journal of Mechanics and Physics of Solids, International Journal of Plasticity, Materials Theory, and the Journal of Elasticity.

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