Department of Engineering Physics
UNIVERSITY OF WISCONSIN–MADISON

INSTITUTE FOR NUCLEAR ENERGY SYSTEMS

Presents:

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Recent progress in continuum dislocation dynamics and mesoscale plasticity

Abstract: In the recent years, the method of discrete dislocation dynamics simulation has become popular in studying plasticity of crystals at the microscale and small strains (~0.1%). Practical levels of crystal deformation encountered in experiments require the development of dislocation based theories of plasticity that capture the deformation mechanisms at a larger scale. The method of continuum dislocation dynamics is believed to meet this objective. The method casts the dislocations dynamics problem in the form of transport-reaction equations for crystal dislocations after expressing them in terms of density fields. At this point, however, the method faces theoretical challenges, including modeling of the dislocation reactions, collective dislocation mobility, short range interaction effects, and accounting for the finite deformation kinematics in its mathematical formulation. These issues will be discussed in this presentation, along with theoretical and computational progress made within the Materials Theory Group at Purdue. The continuum theory of dislocations is generalizable to the defects produced in materials under irradiation. Extension of the concepts included in this presentation to the problem of radiation effects in materials provides a new theoretical framework for radiation effects – it will be shown for the first time that the elegant framework of continuum mechanics can be used as the theoretical basis for modeling all defect processes relevant to understanding and predicting radiation effects in materials.

***Biography*:** Anter El-Azab is a professor of Materials Science and Engineering and Nuclear Engineering (by Courtesy) at Purdue University. His research and teaching focus on Microstructure Science of Materials. Prior to coming to Purdue, he held a full professor position at Florida State University in Scientific Computing and Materials Science and Engineering. Prior to that, he spent six years as a Research Scientist with Pacific Northwest National Laboratory. Professor El-Azab obtained his doctoral degree in Nuclear Engineering/Materials from the University of California, Los Angeles. He is the founding editor and editor in chief of Materials Theory, a Springer-Nature journal that was launched recently. He was the chairman of the 4th International Conference on Multiscale Modeling of Materials (2008) and the Dislocations-2016 Conference (2016). He served as guest editor for Philosophical Magazine, Journal of Applied Physics, Modelling and Simulation in Materials Science and Engineering, and SIAM Journal of Multiscale Modeling. He is the author and co-authors of over 130 journal and refereed conference papers and close to ten special journal issues and proceedings volumes. Dr. El-Azab is most known for his work on mesoscale theory of metal deformation, radiation effects in materials, defect disorder in oxides, and development of computational methods for materials and mechanics applications.

Tuesday, 2/5/2019
12:00 PM, ERB 106