# PRISM Seminar Series – Fall 2012

PRISM
NNSA Center for Prediction of Reliability, Integrity and Survivability of Microsystems

PURDUE UNIVERSITY Discovery Park

## "Plastic localization in irradiated ferritic systems: new insights from modeling and simulation"


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***Friday, December 7th, 2012***
***12:00 pm, BRK 2001***


***Abstract***: Low temperature irradiation of crystalline materials is known to result in hardening and loss of ductility, which limits the usefulness of candidate materials in harsh nuclear environments. In bcc metals, this mechanical property degradation is caused by the interaction of in-grown dislocations with irradiation defects, particularly small dislocation loops resulting from the microstructural evolution of displacement cascades. In this work, we present a multi scale model encompassing dislocation dynamics (DD) simulations, crystal plasticity, and finite element (FE) simulations of bcc Fe containing various concentrations of dislocation loops produced by irradiation in an attempt to gain insight into the processes that lead to hardening and embrittlement. The DD simulations reveal a transition from homogenous to highly localized deformation at a critical loop density. Above it, plastic flow proceeds heterogeneously, creating defect-free channels in its wake. These simulations are then used to calibrate a tensorial crystal plasticity model capable of reaching strains in excess of 10%. The calibrated crystal plasticity model is used as the constitutive relation in FE simulations of polycrystalline irradiated Fe systems.


***Speaker Bio:*** Jaime Marian received a mechanical engineering degree from Universidad Politécnica de Madrid, Spain, and a PhD in nuclear engineering from the University of California at Berkeley. He then spent two years at the California Institute of Technology as a Postdoctoral Scholar after which he moved to Lawrence Livermore National Laboratory (LLNL) where he is now a staff scientist. His work involves the simulation of multiple aspects of materials degradation and failure in far-from-equilibrium environments.
His focus is on the development and application of efficient numerical techniques to improve structural materials performance for high irradiation, high heat and high strain rate conditions. Dr Marian has over 50 peer-reviewed articles in scientific journals and is the recent recipient of a 2012 DOE Early Career Award.

***Refreshments will be served.*** *For further information please contact Matthew Potrawski, mpotraws@purdue.edu*
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