COLLEGE OF ENGINEERING
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Mechanical Engineering Seminar Series

Toward Understanding Mechanical Failure of Irradiated Metals

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University of Alabama

3:00 PM

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1200 EECS

ME Seminar Zoom link

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Abstract

Structural alloys in next-generation nuclear reactors are expected to operate for long service lives while subjected to high irradiation doses and mechanical loading. Irradiated metals and metallic alloys tend to exhibit changes in macroscopic mechanical properties compared to their unirradiated counterparts, including an increase in strength and loss of ductility due to the presence of irradiation-induced defects. However, we lack a rigorous understanding of the micromechanical mechanisms that influence these macroscopic phenomena. In this study, micromechanical experiments are performed in situ during deformation loading on unirradiated and irradiated samples of a model BCC alloy, Fe-9wt.%Cr, via high-energy X-ray diffraction microscopy. Experimental results indicate that the micromechanical behavior deviates more substantially from classical expectations in the irradiated samples than in the unirradiated samples, including an increased propensity of irradiated samples to exhibit granular fragmentation. Crystal plasticity finite element simulations are utilized to test the hypothetical presence of irradiation-induced slip strength anisotropy and its effect on the micromechanical behavior of the material. Simulation results are discussed in light of the experimental observations and suggest slip strength anisotropy as a contributing mechanism to the experimentally witnessed non-classical behavior.

Bio

Matt Kasemer is an assistant professor in the Department of Mechanical Engineering at the University of Alabama, with a courtesy appointment in the Department of Metallurgical and Materials Engineering. Prior to joining UA, Matt earned his M.S. and Ph.D. from Cornell University with a focus on computational solid mechanics, followed by an appointment as a postdoctoral researcher in the Department of Microstructure Physics and Alloy Design at the Max-Planck-Institut für Eisenforshung. Matt's expertise is in computational modeling of polycrystalline materials and the intersection of simulations and experiments, primarily utilizing data from high energy X-ray diffraction experiments. Matt's research is funded through various federal agencies, including an NSF CAREER award.