NOMATEN SEMINAR

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Elucidating Three-Dimensional Microstructural Evolution in Neutron Irradiated HT-UPS Steel

ABSTRACT:

High temperature-ultrafine precipitate strengthened (HT-UPS) steel has the potential to be used as a structural material in advanced nuclear reactors. However, the response of the HT-UPS steel to neutron irradiation is not very well known. Hence, this work investigates the three-dimensional (3D) microstructural evolution of the HT-UPS steel specimens neutron irradiated to 0.003 displacements per atom (dpa), 0.03 dpa, and 0.3 dpa at 600℃.
Various neutron-irradiation-induced effects were examined via synchrotron X-ray techniques such as the X-ray absorption near edge structure spectroscopy (XANES), micro-computed tomography (μ-CT), and high-energy diffraction microscopy (HEDM). The physical and chemical stability/instability of the chemical constituents such as the Fe, Cr, and Ni was studied following neutron irradiation via XANES. Novel pre- and post-irradiation precipitate distribution evolution study for the same HT-UPS steel specimen was conducted to observe nucleation, growth, and/or ballistic dissolution of $Cr_{23}C_6$ precipitates via μ-CT.
Similar novel studies were also performed to understand the grain characteristics evolution via HEDM. Studies of HT-UPS steel specimens for pre- and post-annealing at 600℃ were utilized to differentiate annealing effects from irradiation effects. Overall, this research provides one of the first insights into the microstructural changes in HT-UPS steel with low fluence neutron irradiation ($\leq$ 0.3 dpa), which can be used to predict the material behavior at higher fluences.

BIO:

He received a Ph. D. degree from Purdue University, USA. Worked together with Prof. Okuniewski to investigate the three-dimensional microstructural evolution of high-temperature ultra-fine-precipitate-strengthened steel following neutron irradiation via synchrotron-based techniques.

Won multiple research awards, which enabled the collaboration with various US national laboratories, such as the Argonne National Laboratory, Idaho National Laboratory, and Sandia National Laboratory for conducting experiments and further data analysis.
His broad research interests include the assessment of microstructural and property evolution of structural materials such as steels, Al alloys and High-entropy alloys for nuclear applications and generate inputs for modeling the response of structural materials under irradiation.