In-situ X-ray Diffraction and 4D X-ray Microscopy Study of Tensile Deformation of Neutron-irradiated Fe-9Cr Alloy

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The tensile deformation of a neutron-irradiated (450C/0.1dpa) Fe-9Cr alloy was studied by far-field high-energy x-ray diffraction microscopy (ff-HEDM) at intermittent loading steps, along with *in-situ* wide-angle x-ray scattering (WAXS) during the loading process. Its unirradiated counterpart was also studied in the same way. The irradiated sample showed a much higher yield stress (295MPa vs. 125 MPa). Both samples was deformed to ~7% engineering strain. 5 to 6 ff-HEDM measurements were performed in the plastic regime by pausing the deformation at different strain levels and unloading. The series of ff-HEDM data enables the tracking of a particular ensemble of grains as they deform, obtaining information on their individual centroid locations, misorientation development, and microstrain development, while the WAXS provides information about the entire diffracting volume on the lattice strain evolution, dislocation density evolution, as well as the coherent scattering domain size. This comprehensive dataset provides unpreceded information regarding the effect of neutron irradiation to the deformation mode of the Fe-9Cr ferritic alloy, across multiple length scales from macro to meso to micro. The data will also serve as reference data for computer modeling.