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

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High-temperature ultrafine precipitation strengthened (HT-UPS) steel is an advanced austenitic steel that was initially developed for fossil plant applications, but has more recently garnered attention for the use in advanced nuclear reactors. HT-UPS was found to have improved creep resistance compared to 316 stainless steel due to the nano-precipitate formation of titanium and niobium metal carbides (MC). However, little is known about the radiation response of these materials. This research utilizes a variety of advanced characterization techniques, including synchrotron diffraction and micro-computed tomography, extended X-ray absorption fluorescence spectroscopy, and electron microscopy to elucidate the three-dimensional microstructural evolution of HT-UPS subjected to low neutron doses. This study focuses on the changes observed in the MC precipitates, grain characteristics, lattice parameters, and micro-strain.