ICSMA19 Metz, France, June 26 - July 1, 2022
International Conference on Strength of Materials

Recovery Of Irradiation Induced Dislocations In HT-9 Steel Coupons Removed From A Nuclear Reactor Fuel Duct

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High resolution neutron diffraction data was collected in-situ during annealing of material harvested from several positions within a nuclear fuel duct (the ACO-3 duct) used in a six-year irradiation of a fuel assembly in the Fast Flux Test Reactor Facility (FFTF). Previous reported results documented the as-radiated dislocation density of the coupons, each of which had experienced a distinct thermal and irradiation history. The three samples with the highest dislocation density, of order $1x10^{15}$/m2, were heated to nominally 700°C while diffraction data was collected. A sharp reduction of the diffraction peak breadth above ~450°C is interpreted as the onset of recovery. This behavior was identical, to within measurement uncertainty, between the three irradiated specimens with distinct histories. As a comparison, parallel measurements were completed on a control (non-irradiated) specimen of the same pedigree deformed to a strain of 0.1 in compression to induce a similar initial dislocation density. The recovery behavior of the deformed sample with increasing temperature was significantly different from the irradiated samples. The talk will present attempts to understand the distinct behavior of the dislocations in the irradiated and deformed materials based on advanced microstructural modelling.

Keywords: Diffraction, Line Profile Analysis, Nuclear Material, Recovery