EFFECT OF PERIODIC TEMPERATURE VARIATIONS ON THE MICROSTRUCTURE OF NEUTRON-IRRADIATED METALS

S.J. Zinkle, N. Hashimoto and D.T. Hoelzer, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6376

Modest temperature excursions are expected to be a common occurrence in any commercial nuclear system due to scheduled startup and shutdown events. Some ion irradiation and low-dose neutron irradiation studies have found that these temperature excursions may exert a significant influence on the microstructural evolution, particularly if the temperature excursion transcends the recovery Stage V temperature regime (which corresponds to thermal dissociation of small vacancy clusters). In the present study, specimens of pure copper, CuCrZr, Type 316 stainless steel, 9Cr-2WV ferritic martensitic steel, and V-4Cr-4Ti were exposed to eight cycles of periodic temperature variations during neutron irradiation in the High Flux Isotopes Reactor to a cumulative damage level of 4 to 5 displacements per atom. Specimens were exposed to a low temperature during the initial 10% of accrued dose in each of the eight cycles, and were exposed to a higher temperature during the remaining 90% of accrued dose in each cycle. Different specimens were exposed to low/high irradiation temperatures of 200/350°C and 300/500°C. The transmission electron microscopy results will be compared with the microstructure of companion specimens which were continuously maintained at 350°C and 500°C, respectively during the entire irradiation.

This research was sponsored by the Office of Fusion Energy Sciences, U.S. Department of Energy under contract DE-AC05-00OR22725 with UT-Battelle, LLC.