HIGH SPATIAL RESOLUTION X-RAY MICROANALYSIS OF RADIATION-INDUCED SEGREGATION IN PROTON-IRRADIATED STAINLESS STEELS

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Irradiation-assisted stress corrosion cracking (IASCC) of neutron-irradiated austenitic alloys has been attributed in part to radiation-induced segregation of both major and minor alloying elements near point defect sinks, especially grain boundaries. As a result of the low irradiation temperature (<570 K), the segregation profiles are very narrow (<5 nm) and require the high spatial resolution of a field emission gun scanning transmission electron microscope (FEG-STEM). Energy-dispersive spectrometry (EDS) spectrum lines have been utilized to characterize both pre-irradiation segregation associated with prior heat treatment and radiation-induced segregation produced by proton-irradiations used to simulate neutron irradiation. The segregation evolves from Cr- and Mo-enrichment at grain boundaries prior to irradiation to "W-shaped" Cr profiles at ~1 dpa (displacement per atom) to "traditional" Cr depletion profiles with increasing dose. This redistribution is accompanied by Si, Ni, and P enrichment at boundaries. The impact of pre-irradiation segregation on subsequent RIS and the role of RIS on IASCC will be discussed.

Research sponsored in part by U.S. Department of Energy, Division of Materials Sciences, under contract DE-AC05-96OR22464 with Lockheed Martin Energy Research Corp. and through the SHaRE User Program under contract DE-AC05-76OR00033 the Oak Ridge Institute for Science and Education. Research in part utilized the Shared Research Equipment (SHaRE) User Facilities at Oak Ridge National Laboratory.