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Assessment of Radiation Embrittlement in Nuclear Reactor Pressure Vessel Surrogate Materials DAVOR BALZAR, Department of Physics and Astronomy, University of Denver — The radiation-enhanced formation of small (1-2 nm) copper-rich precipitates (CRPs) is critical for the occurrence of embrittlement in nuclear-reactor pressure vessels. Small CRPs are coherent with the bcc matrix, which causes local matrix strain and interaction with the dislocation strain fields, thus impeding dislocation mobility. As CRPs grow, there is a critical size at which a phase transformation occurs, whereby the CRPs are no longer coherent with the matrix, and the strain is relieved. Diffraction-line-broadening analysis (DLBA) and small-angle neutron scattering (SANS) were used to characterize the precipitate formation in surrogate ferritic reactor-pressure vessel steels. The materials were aged for different times at elevated temperature to produce a series of specimens with different degrees of copper precipitation. SANS measurements showed that the precipitate size distribution broadens and shifts toward larger sizes as a function of ageing time. Mechanical hardness showed an increase with ageing time, followed by a decrease, which can be associated with the reduction in the number density as well as the loss of coherency at larger sizes. Inhomogeneous strain correlated with mechanical hardness.

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