

Synergistic Effects of Neutron Irradiation and Interstitial Nitrogen on Strain Aging in Ferritic Steels

Authors: N. Kumar, A. Alsabbagh, C.S. Seok, K.L. Murty

Abstract: Ferritic steels that are generally used in pressure vessels and various reactor support structures in light water reactors exhibit dynamic strain aging (DSA) resulting in increased work-hardening accompanied by ductility loss. While there is a possibility of adding this embrittlement known as blue brittleness to the well-known radiation embrittlement, it has been amply demonstrated that radiation exposure leads to decreased concentrations of interstitial impurity atoms in solution. Thus the critical temperature for DSA increases with increased neutron fluence very similar to the increase observed in dry hydrogen treated mild steel samples with decreased concentration of nitrogen in solution with increased treatment time. We summarize here the mechanical and fracture studies made on three different materials: a mild steel and two ferritic steels (A533B and A516 Grade70). In addition, effects of interstitial nitrogen are evaluated by heat treating to different times in dry hydrogen atmosphere.