Proceedings of the Korean Nuclear Society Autumn Meeting
Hanyang Univ., Seoul, Korea, Oct. 30 - 31 1998

Neutron Irradiation Effects on the Microstructural Dependence of Mechanical Properties of SA 508 Cl. 3 RPV Steels

Se-Hwan Chi[1], Milan Brumovsky[2]
Korea Atomic Energy Research Institute
P.O Box 105, Yusong, Taejon, 305-600 Korea
Nuclear Research Institute Rez plc 250 68 Rez Czech Republic

Abstract

Differences in the neutron-induced mechanical property change for four kinds of reactor pressure vessel (RPV) steels of different manufacturing process were investigated based on the differences in the unirradiated microstructure. Microvickers hardness, indentation, and miniature tensile specimen tests were conducted for mechanical property measurement and optical microscope (OM) and transmission electron microscope(TEM) were performed for microstructural characterization. Specimens were irradiated to a neutron fluence of 2.7 x 10^{19}n/cm^2 (E≥ 1 MeV) at 288℃. Investigation on the unirradiated microstructures showed largely the same microstructure in that tempered acicular bainite and ferrite with bainitic phase are prevailing. Noticiable differences were observed in the grain size and distribution of cementite, and bainitic lath microstructures. No noticiable changes were observed in the optical and thin film TEM microstructures after irradiation. Apparent differences, however, were observed in the results of mechanical testing after irradiation. Results of tensile testing and hardness measurement show that the present steel refined by vacuum carbon deoxidation(VCD) method exhibits exceptionally high radiation hardening behavior among the four kinds of steel of similar chemical composition examined in the present study. This observation implies that the current irradiation embrittlement prediction method based only on the major alloying elements and fluence could yield nonconservative prediction for this steel. The present results strongly suggest that a new material-specific embrittlement prediction method that considers the differences in the unirradiated microstructural state should be developed and applied .