Proceedings of the Korean Nuclear Society Autumn Meeting
Seoul, Korea, October 1998

The changes of the structural, magnetic and mechanical properties in a RPV steel neutron irradiated at 70℃

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Abstract

The irradiation embrittlement of reactor pressure vessel (RPV) steel has been one of the main safety concern in the nuclear power plant. In the present study a SA508-3 RPV steel was irradiated by neutron with various fluence up to 10^{18} n/cm^2 (E > 1 MeV) at a temperature of approximately 70 ℃. The irradiation responses of the structural, magnetic and mechanical properties of RPV steel were investigated by means of X-ray diffraction, Moessbauer spectra, magnetic Barkhausen noise and micro Vickers hardness measurements. The transition of all of these parameters occurred above the neutron dose of 10^{16} n/cm^2. The results of X-ray and Moessbauer experiments revealed that neutron irradiation leads to the possibility of the partial amorphization in the investigated RPV steel. The changes of physical and mechanical properties can be explained in terms of irradiation induced cascade damage of crystalline materials.