The Influence of Delta(δ) Ferrite on the Irradiation Effects in Type 304 Stainless Steel Weldment

Se-Hwan CHI, Gen-Chan Kim, Jun-Hwa Hong
Nuclear Materials Development Team, Korea Atomic Energy Research Institute
P.O Box 105, Yusong, Taejon, 305-600, South Korea

Yong-Kwan Shin ,Young-Jik Kim
Department of Advanced Materials Engineering, Sungkyunkwan University,
Chongchon-dong, Suwon, Kyonggi-do, 400-746, South Korea

Abstract

Differences in the high energy ion induced defects microstructure of BCC δ -ferrite and FCC austenite matrix, and the effects of δ -ferrite on the Vickers micro-hardness increase after irradiation were investigated for Type 304 stainless steel weldments containing two different δ -ferrite contents : ferrite number(FN) 5.5 and 8.5, respectively. Specimens were irradiated to 1.5 dpa by 8 MeV Fe^{+4} ions using a Tandem Vande-Graff accelerator (flux: 4.3 x 10^{10} ion/cm^2.sec, fluence : 0.83 x 10^{15} ion/cm^2) at room temperature. TRIM 95 results showed that a peak damage appeared at 1.5 ㎛ in depth with 0.7 ㎛ full width at half maximum (FWHM), and these results could have been confirmed by TEM on irradiation induced defects (IID) distribution. Clear differences in the size and number of IID in the form of black dots (size: 5 - 10 nm) and loops were observed between the austenitic matrix and δ -ferrite, where the size of IID was far larger in FCC matrix than BCC δ -ferrite. Vickers micro-hardness (Hv) test results showed that δ -ferrite has increased about five times higher than austenitic matrix after irradiation. This observation was used to explain the higher Vickers micro-hardness increase due to irradiation in the high FN weldment than the lower FN weldment, i. e., 44 % increase for 8.5 FN to 36% increase for 5.5 FN after irradiation.