3 - 8 Tensile Properties of SA 316LN Irradiated in STIP-II

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The materials chosen for this study are SA 316LN. The steel was solution annealed at 1050 ℃ for 30 min. The chemical composition in wt. % is: 17. 45Cr, 12. 2Ni, 2. 5Mo, 1. 81Mn, 0. 024C, 0. 39Si, 0. 067N, and balance Fe.

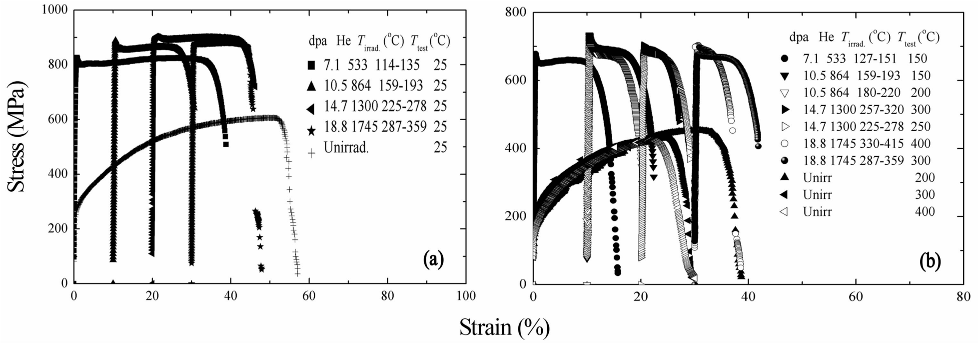

Fig. 1 Tensile stress-strain curves of unirradiated and irradiated SA 316LN specimens tested at RT (a) and at approximate irradiation temperatures between 150 °C and 400 °C (b).

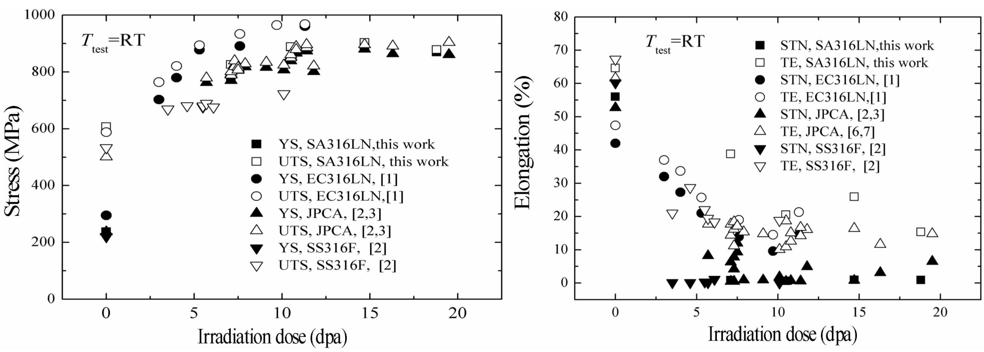

Fig. 2 Irradiation dose dependence of the YS, ultimate tensile strength (UTS), STN and TE of 316-type austenitic stainless steels irradiated in SINQ and tested at RT.

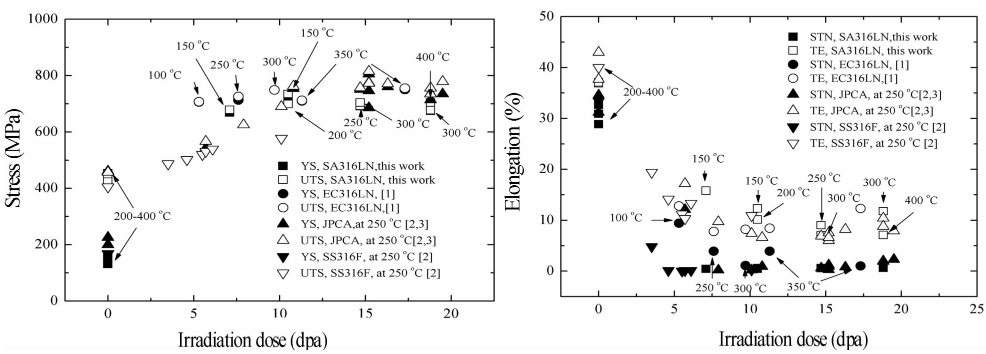

Fig. 3 Irradiation dose dependence of the YS, UTS, STN and TE of 316-type austenitic stainless steels irradiated in SINQ and tested at temperatures between 150～400 ℃. The temperature values indicated in the figure are the testing temperatures.

Solution-annealed (SA) austenitic stainless steel 316LN were supplied by the Oak Ridge National Laboratory and irradiated in the second SINQ target irradiation experiment (STIP-II) to doses between 5 and 20 dpa at temperatures between 80 ℃ and 450 ℃. Tensile tests were conducted at room temperature and

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irradiated temperatures. Yield stress (YS) increased significantly by irradiation and saturated above about 10 dpa. The irradiation embrittlement effects are significant in the specimens because the strain to necking (STN) reduced sharply to less than 1% after 7.1 dpa irradiation, as shown in Figs. 1~3. For comparison, the tensile properties of SA316LN, JPCA, SS316F, EC316LN stainless steels irradiated in SINQ are plotted in Figs. 2 and 3 for test temperatures of RT and elevated temperatures, respectively. Irradiation-induced hardening and decrease in the work hardening capacity are similar in these austenitic steels.

References

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[2] S. Saito, K. Kikuchi, K. Usami, et al., J. Nucl. Mater., 343(2005)253.
[3] S. Saito, K. Kikuchi, D. Hamaguchi, et al., J. Nucl. Mater., 431(2012)44.

3 - 9 Thermal Desorption and Surface Modification of Tungsten Implanted by 100 keV He-ions

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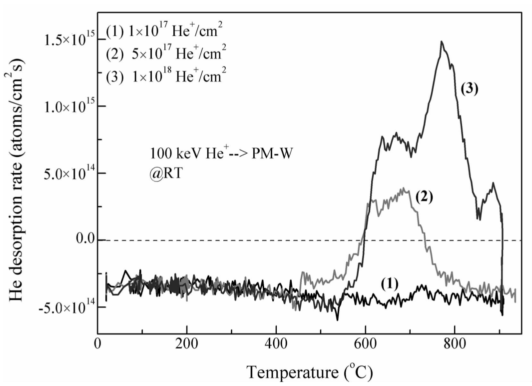

Fig. 1 THDS of the specimens implanted with 100 keV He^+ at RT to different doses.

Tungsten is a candidate material for divertor in fusion reactors due to its high melting point and good thermal performance[1]. Helium introduced by burning plasma and neutron irradiation in tungsten will possibly re-emit into the core plasma and affect the safety. Thermal desorption behavior of helium in tungsten needs to be understood to estimate the amount of helium re-emission. In this work, the dose dependence of helium desorption behavior in tungsten was investigated.

The tungsten specimens with high purity of 99.99% were irradiated with 100 keV He^+ at room temperature (RT). The mean flux was about 4.7×10^{13} ions/(cm^2 s). The doses were low 1.0×10^{17}, middle 5.0×10^{17} and high 1.0×10^{18} ions/cm^2. After irradiation, He desorption behavior was investigated by Thermal He Desorption Spectroscopy (THDS) and SEM was used after THDS to identify the surface morphology.

Thermal helium desorption spectra for the case of 100 keV He^+ irradiation at RT is shown in Figs. 1. It should be illustrated that the He desorption rates below zero are considered as background, i.e. zero, and only those data above zero will be discussed.

The He desorption spectra indicated that when the temperature was not above 900 ℃ the desorption behavior suddenly changed at the middle dose of 5.0×10^{17} ions/cm^2 with several peaks. Therefore the threshold dose of He desorption is between 1.0×10^{17} and 5.0×10^{17} ions/cm^2, which is almost the same as the case of 8 keV in Ref. [1]. The temperature range of He desorption, the temperature and desorption rate at the peak as well as the total desorption for the two specimens are listed in Table 1. In the case of 5.0×10^{17} ions/cm^2, He atoms releasing started at about 585 ℃ and stopped after about 730 ℃ with two peaks between them. When the dose increased to 1.0×10^{18} ions/cm^2, He desorption started at about 598 ℃ and four peaks appeared below 900 ℃. The helium desorption rates at the two lower peaks were more than twice the rates of the specimen with 5.0×10^{17} ions/cm^2. The total He desorption was also much higher in the case of the high dose. The total desorption did not show the saturation of the total desorption and did not reach the saturation value of 1.0×10^{17} ions/cm^2 as reported in other studies[1-2] probably because the maximum annealing temperature was lower in our work.