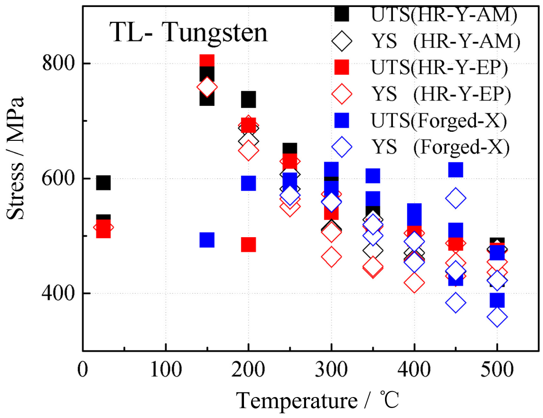

Fig. 3 (color online) Ultimate tensile strength and yield strength comparison at different temperatures.

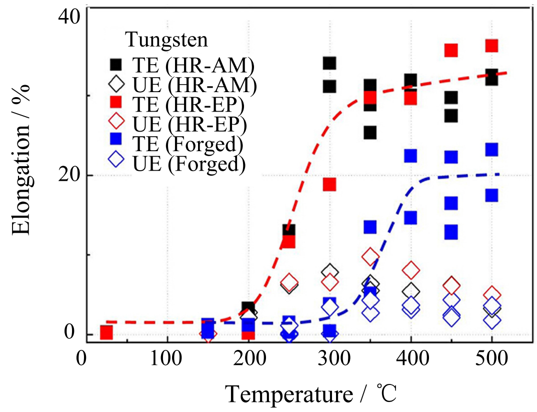

Fig. 4 (color online) Elongation comparison of different tungsten at different temperatures.

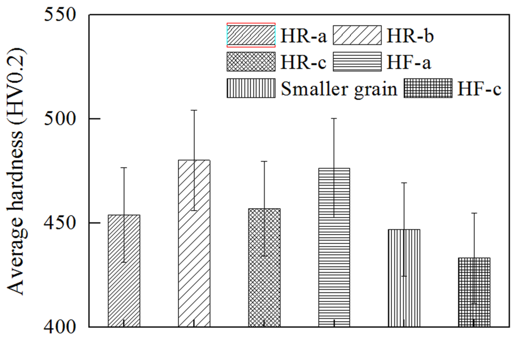

Fig. 5 The average hardness depending on different planes of both hot rolled and forged samples.

parison between rolled and forged sample, the hot rolled sample has larger ultimate tensile strength than that of forged. It is found that the transition temperature from brittletoductile fracture for forged tungsten is higher than that of rolled tungsten (Fig. 4), whereas the total elongation of the rolled tungsten is significantly larger than that of the forged tungsten at the temperature range of 250∼ 500 °C. The hardness values of both rolled and forged samples are almost the same (Fig. 5). Only some difference was observed in different directions due to thermal mechanical treatment.

3 - 3 Microstructure Evolution in EC316LN Austenitic Stainless Steel Irradiated in STIP-Ⅱ *

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Austenitic stainless steels are a class structural material applied in current nuclear reactors and spallation targets as well as future nuclear devices. It is well known, the migration and interaction of defects and their clusters and small dislocation loops caused by irradiation induce changes in mechanical properties of materials and result in radiation hardening and ductility loss of materials. In the present study, microstructure evolution in EC316LN austenitic steel irradiated with mixed spectra of high-energy proton and spallation neutrons has been investigated by using Transmission Electron Microscopy (TEM).

The EC316LN austenitic steel was irradiated in the second experiment of the SINQ Target Irradiation Program to the dose ranged from 5.8 to 19.5 dpa at temperatures between about 112 and 375 °C. Carefully TEM observation (Fig. 1) shows that dense dislocation loops with sizes of about 2 nm in diameter are visible at lower doses, and the density of these smaller loops (black dots) is very high. In the low temperature regime, the loop density reaches a saturation level whereas the loop size distribution changes with increasing dose. At damage level above 16.5 dpa, corresponding irradiated temperature 283 °C, the average size of loops increases significantly with increasing the damage level, while the density of smaller loops decrease rapidly. It should be noted that the density of smaller loops (cluster) saturates and keeps the value of around 3×10^{23} m^{-3}, whereas, the mean size of larger loops increases and the density decreases with increasing of dose according to the results obtained from weak beam dark field images.

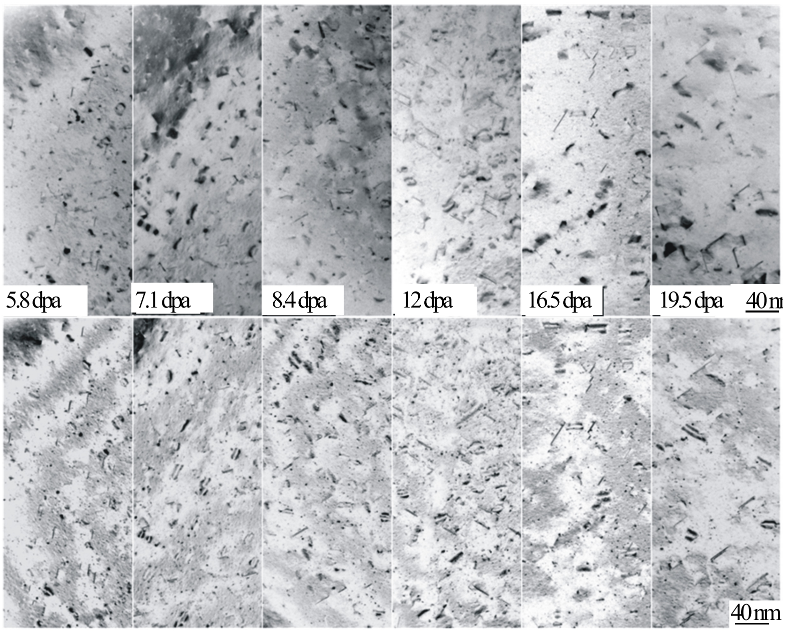

Fig. 1 Both bright field and corresponding weak beam dark field inverted contrast images showing the loop structure in 316 steel irradiated at different conditions.

In this work both weak beam dark field and rel-rods imaging techniques were employed for detecting small defect clusters and dislocation loops. The typical microstructure of loop obtained from rel-rods techniques was presented in Fig. 2. The average size of visible loops increased from about 11 nm at low dose to 22 nm at high dose, whereas the density decreased from 4.4×10^{22} to 1.2×10^{22} m^{-3}. The comparison between weak beam dark field and Rel-rods images shows that the loops in rel-rods images have a little bigger size and smaller density.

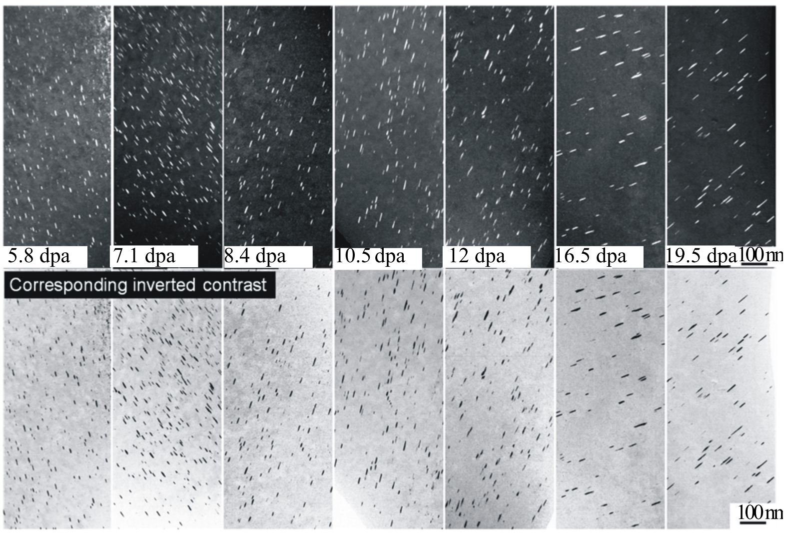

Fig. 2 Rel-rods images showing the edge-on loop structure in 316steel irradiated at different conditions.

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