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3 - 18 Nano-hardness of Chinese RAFM Steel Irradiated with Energetic Kr, Xe and Bi Ions

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In the present work, nano-indentation hardness of Chinese RAFM steel irradiated with Kr, Xe and Bi ions at different temperature were investigated. The energetic Kr, Xe and Bi ions irradiation experiment was performed at the materials research terminal of 320 kV Multi-discipline Research Platform for Highly Charged Ions. Kr, Xe and Bi ions with a kinetic energy of 4, 5 and 6 MeV were used for the irradiation, respectively. The ion beam was raster scanned by using two sets of triangle wave generator electric source installed at the front beam line, with scanning frequencies of 1.0 kHz and sanning voltage 0.8 kV in the horizontal direction and 1.0 kV in the vertical direction, respectively.

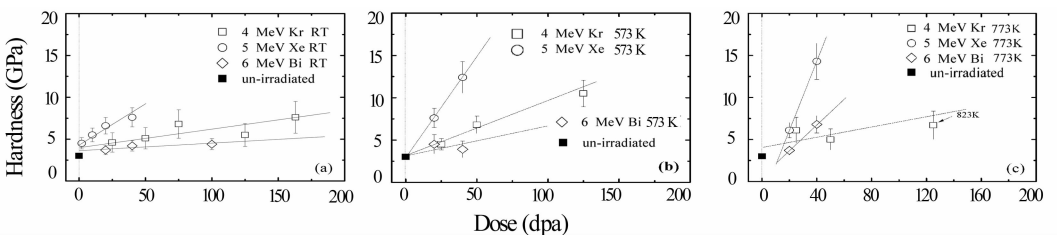

Fig. 1 Peak nano-hardness of Chinese RAFM steel irradiated with Kr, Xe and Bi ions as a function of damage level at different temperatures: (a) RT; (b) 300℃; (c) 500℃.

After irradiation, nano-hardness of the samples was investigated by using MTS corporation G200 nano-indenter. The nano-indentation measurements were performed by using a triangular pyramid Berkovic indenter. Nano-hardness profiles were obtained by a contact pressure evaluation method. Fig. 1 gives the peak nano-hardness of Chinese RAFM steel irradiated with Kr, Xe and Bi ions as a function of damage level at different temperatures. Each data point in the nano-indentation graph represents the peak hardness corresponding to peak damage region at the end of energetic ions projectile ranges. Based on the analysis of nano-hardness results, it shows that the nano-hardness of irradiated Chinese RAFM steel increases obviously with increasing of irradiation dose and temperature. At the same temperature, there is an approximate linear relationship between nano-hardness and irradiation dose. With temperature increasing, nano-hardness as a function of irradiation dose increases more quickly. The maximum value (~15 GPa) of nano-hardness appears in Chinese RAFM steel irradiated with 5 MeV Xe ion at 500℃ to dose of 40 dpa. The nano-hardness of Chinese RAFM steel results suggest that there is obviously a close relationship between nano-hardness and irradiation ions, dose and temperature. The different kinds of defects induced by irradiation may play an important role in the slip process of dislocation line and resulted in the nano-hardness increase.