Study of Irradiation Damage Induced by Helium Ion in Fe-based Metallic Glass XIANXIU MEI, XIAONAN ZHANG, JIANBING QIANG, YOUNNIAN WANG, Dalian University of Technology, KEY LABORATORY OF MATERIALS MODIFICATION BY LASER, ION AND ELECTRON BEAMS TEAM —

The changes in structure and surface morphology of metallic glasses Fe$_{80}$Si$_{7.43}$B$_{12.57}$ and Fe$_{68}$Zr$_7$B$_{25}$ before and after the irradiation of He ions with the energy of 300keV were investigated, and were compared with that of the tungsten. In metallic glass Fe$_{80}$Si$_{7.43}$B$_{12.57}$, when the fluence of He ions was up to $4 \times 10^{17}$ions/cm$^2$ (19dpa), crystallization occurred, and a small amount of metastable $\beta$-Mn type phase nanocrystals formed. When the fluence increased to $1 \times 10^{18}$ions/cm$^2$ (47dpa), the quantity of nanocrystals increased and metastable $\beta$-Mn type phase transformed into $\alpha$-Fe phase and tetragonal Fe$_2$B phase. Then orthogonal Fe$_3$B phase and $\beta$-Mn type phase formed and were added to the nanocrystals as the fluence increased to $1.6 \times 10^{18}$ions/cm$^2$ (69dpa), while metallic glass Fe$_{68}$Zr$_7$B$_{25}$ maintained amorphous under the He ion irradiation, till the fluence was up to $1.6 \times 10^{18}$ions/cm$^2$ (69dpa). This indicates that the irradiation resistance of Fe$_{68}$Zr$_7$B$_{25}$ is better. After the irradiation, different damage morphologies were exhibited on the surfaces of the two kinds of Fe-based metallic glasses. When the fluence was $1.6 \times 10^{18}$ions/cm$^2$, cracks and ductile shear steps appeared on the surface of metallic glass Fe$_{80}$Si$_{7.43}$B$_{12.57}$, and spalling as well as brittle fracture morphology appeared on the surface of metallic glass Fe$_{68}$Zr$_7$B$_{25}$. However, blisters and spallings occured on the surface of tungsten at the irradiation fluence of $1 \times 10^{18}$ions/cm$^2$, and with the increase of irradiation fluence, the spalling phenomenon became more serious. Thus the irradiation resistance of Fe-based metallic glasses is better than that of tungsten.

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