This indicates that defects could accelerate the decomposition of Ag nanoparticles at higher temperature. The size evolution shown in Fig. 2 obtained from TEM observation indicates that Ag nanoparticles with defects have a lower growth rate than Ag nanoparticles without defects at temperature lower than 750 ℃.

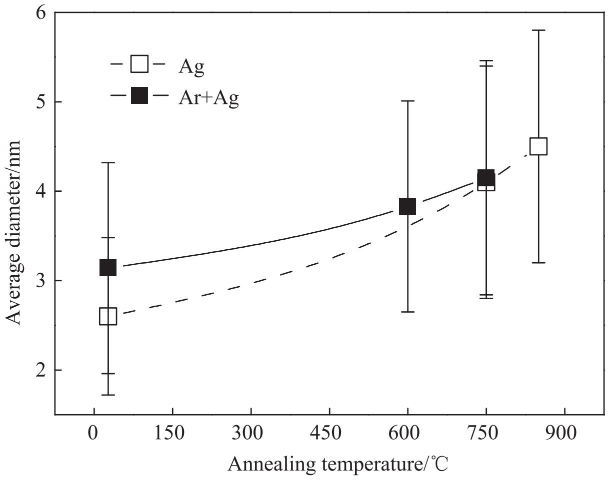

Fig. 2 The evolution of average diameter of Ag nanoparticles with annealing temperature.

4 - 32 Damage Effects of Mechanical Properties of Silicon Carbide Fiber Irradiated by Electron Beams*

Zhang Liqing, Zhang Chonghong, Chen Yuguang, Yan Tingxing, Xiao Rongqing and Zhang Zimin

Continuous silicon carbide fiber reinforced silicon carbide (SiC_f/SiC) composites have been considered to be candidate materials of high temperature structural application in aerospace, energy conservation and power generation due to the excellent high temperature mechanical properties, good fracture resistance, corrosion resistance and thermodynamic stability. Furthermore, due to the high thermal stability, low induced radioactivity, quick decay of activity and low afterheat, SiC_f/SiC composites have been recognized as the promising materials of fission and future fusion reactors. SiC_f/SiC composites are composed of SiC fiber and SiC marix materials. Radiation resistance, oxidation tolerance, fracture toughness and tensile strength of SiC fiber have a direct impact on the SiC_f/SiC composites performance.

In the present work, we have investigated the diameter, tensile strength and elastic modulus of SiC fiber irradiated by 1.2 MeV-electron beams with a beam intensity of 5 mA to different irradiation times at a water-cooled sample stage in the air atmosphere. The 10 μm-diameter SiC fibers, mounted on a copper substrate, were irradiated to different times ranging from 18 to 40 h，corresponding to fluences from 8.1×10^{18} to 1.8×10^{19} e/cm^2. After irradiation, their diameter and mechanical properties were characterized by the electronic vernier caliper and electronic tensile machine, respectively. The mode of the electronic tensile machine is Textechno FAVIMAT$^+$. The span is 25 mm and tensile rate is 1 mm/min.

Results from experiments reveal with increasing irradiation time (electron fluence), the SiC fibers' tensile strength and their elastic modulus first decrease and then increase, while their diameters first show little change and decrease (Figs. 1 and 2). This phenomenon is attributed to the competition between the decomposition and release of pyrolysis products (organic gases) and carbon in SiC fiber and the surface oxidative degradation during irradiation. At lower fluence (18 h) irradiation, the release of pyrolysis gases is predominated, resulting in a slight decrease in fiber' diameter. As the electron fluence (irradiation time) increases, surface oxygen absorption and oxidative degradation govern the mechanical properties and diameters changes, leading to a slight increase in fibers' diameter and a significant decrease in their tensile strength and elastic modulus (Figs. 1 and 2). With the electron fluence further increase, the carbon which is precipitated and segregated from SiC fiber reacts with the pyrolysis products and takes away the partial oxygen on fiber surface, resulting in a rapid reduction in fiber diameter and a remarkable increase in their tensile strength and elastic modulus (Figs. 1 and 2). Author are grateful to staff members for running the electron accelerator in Institute of Modern Physics, Chinese Academy of Sciences for their collaboration.

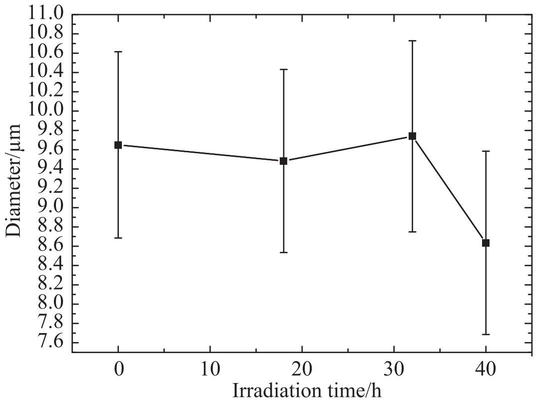

Fig. 1 The diameter of SiC fiber as a function of the irradiation times (electron fluence) after SiC fibers were irradiated by electron beams with different times.

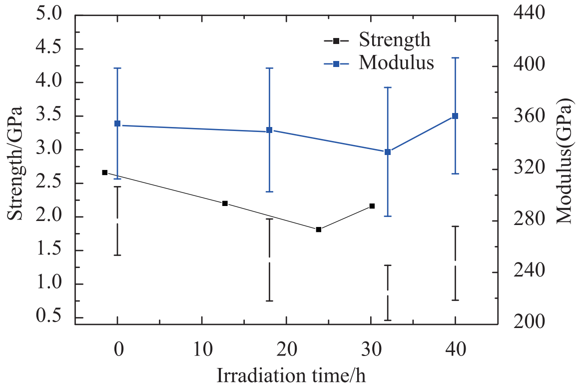

Fig. 2 (color online) The tensile strength and elastic modulus of SiC fiber as functions of the irradiation times (electron fluence) after SiC fibers were irradiated by electron beams with different times.

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4 - 33 Irradiation Hardening of V-4Cr-4Ti and V-5Cr-5Ti alloys Due to Helium Implantation and Displacement Damage

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Vanadium alloys (V-Cr-Ti series) are important candidate materials for blanket components of fusion reactors due to their low activation and high strength at elevated temperatures. Low-temperature irradiation embrittlement determines the operation temperature limit of Vanadium alloys for the application to structural materials of fusion reactors irradiation response of vanadium alloys needs to be clarified for their application.

In the present study, specimens of two alloys (V-4Cr-4Ti and V-5Cr-5Ti) were irradiated with energetic He ions and heavy ions to understand hardening of the alloys due to helium accumulation and cascade damage production. A layer of a uniform helium concentration and displacement damage in the specimens were produced by varying energy of He ions and heavy ions (Ni, Sn), as shown in Fig. 1. Irradiation hardening was tested by using the nanoindentation technique. The results show that the Soft Substrate Effect(SSE) can be effectively avoided in the specimens irradiated with heavy ions (Ni and Sn) with kinetic energies of a few MeV/u. The nano-hardness gradient due to the Indentation Size Effect(ISE) was analyzed by the Nix-Gao model, as shown in Fig. 2. Values of nano-hardness corresponding to the infinite depth were obtained. Fig. 3 shows dose dependence of bulk-equivalent

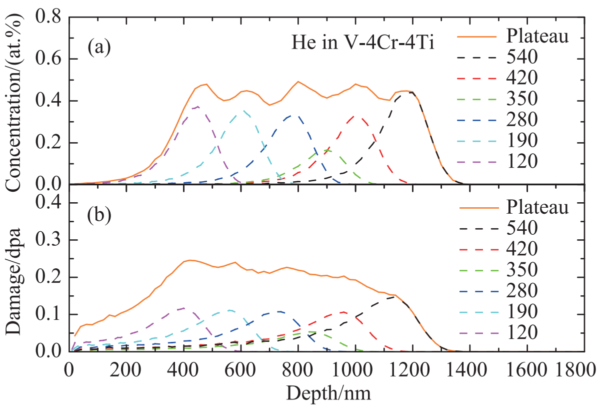

Fig. 1 (color online) The distribution of He ion concentration (a) and DPA (b) in V-4Cr-4Ti obtained from SRIM2013 simulation.