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MICROSTRUCTURE AND PHASE STATE OF A COMPOSITE BASED ON SILICON CARBIDE IRRADIATED WITH KRYPTON IONS

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Due to its wide band gap, high thermal conductivity, good stability, high strength and radiation resistance, silicon carbide is a promising material for use as structural elements in thermonuclear reactors, fission reactors and gas-cooled fission reactors, as well as in the burial of radioactive nuclear waste. Title (EFRE Title style): 11pt, bold, roman, centered, all capitalized, first line indent 0 pt, spacing 6 pt before and 9 pt after, no word wrapping.

Ceramic SiC samples were obtained at IHMT NAS RB by binding two fractions of SiC powders M5 and M50 (grain size 5 microns and 50 microns, respectively) using a thermoplastic binder based on paraffin P-2 and subsequent silicification at a temperature of 1800 ° with and a pressure of 0.13 Pa. As a result, the final Si/SiC ceramics contain about 78% volume fraction SiC and less than 2% of single residual pores with a characteristic size of up to several microns. Before irradiation, the silicon carbide samples were mechanically polished. The samples were irradiated with Kr+ ions with an energy of 280 keV at RT at the DC-60 linear heavy ion accelerator (Institute of Nuclear Physics, Nur-Sultan, Kazakhstan). Irradiations with krypton ions were carried out with fluences 1×10^{13}, 1×10^{14}, 5×10^{15} sm^{-2}.

The study of the structural-phase state of the initial and irradiated SiC samples was carried out by X-ray diffraction analysis (XRD) and scanning electron microscopy (SEM).

The study of the structural-phase state of the initial samples showed that the samples are a composite: SiC-6H, Si and SiC-15R. The main phase is SiC-6H (~ 80%).

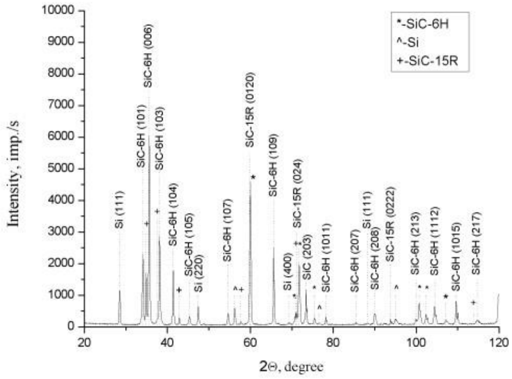

Fig. 1. XRD patterns of the initial SiC.

Irradiation with Kr^+ ions leads to a significant increase in lattice deformation, which is caused by the formation of radiation defects and their clusters. As the dose increases, the relative change in the lattice parameter a decreases, parameter c increases. Such a change in the crystal lattice occurs as a consequence of irradiation growth. This irradiation effect is characteristic of metals with a HCP, especially zirconium [1].

Analysis of the Raman spectra of samples irradiated at doses of 1×1013 and 1×1014 cm-2 showed that with increasing dose, the intensity and broadening of peaks decreases, which is associated with the disordering of the crystal structure, as well as the formation and accumulation of radiation defects in the SiC sample. At a dose of 5×1015 cm-2, there are no peaks of the first order of oscillations, what connected with amorphization of the SiC surface layer, which is also confirmed by the results of SEM.

REFERENCES

[1] Cluster dynamics modeling of irradiation growth in single crystal Zr/ Yang Li , Nasr Ghoniem // Journal of Nuclear Materials 540. – 2020. – 152312.