Nanocomposites and nanomaterials

Effects of deuterium implantation dose on hardness and deuterium desorption temperature range from ZrN coatings

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The effects of the dose of implanted deuterium on hardness, structure, morphology and temperature ranges of deuterium desorption from nanostructured coatings ZrN that deposited from filtered vacuum-arc plasma are investigated.

ZrN coatings characterized by a cubic structure with grain sizes ~ 9 nm and a hardness of about 35 GPa. Nanohardness decreased by 10-15% after implantation of deuterium ions in a dose range from 5×10^{16} to 5×10^{17} D/см^2 and to ~ 50% after dose $\geq 1\times10^{18}$ D/см^2. In the thermal desorption spectra of deuterium from ZrN coatings at low implantation doses present a single peak with a maximum temperature of 1100 K, which is typical for the formation of a solid solution of deuterium in the coating (Fig. 1). At doses > 2×10^{17} D/cm^2 is expanding of deuterium desorption temperature scale. Increasing of the implantation dose is accompanied by growth of the two low-temperature peaks with T_m ~ 500 K and 600 K, that indicating the formation of hydrides in the ZrN coatings. Decrease nanohardness of ZrN coatings after irradiation due to the formation of a solid solution of deuterium and hydrides.

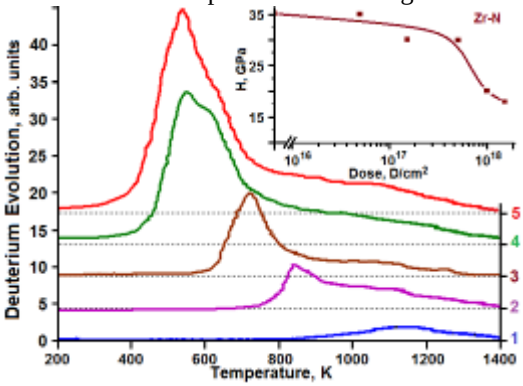

Fig. 1. Thermal desorption spectra of deuterium from ZrN coatings, that irradiated with doses: (1) – 2×10^{17} D/cm^2; (2) – 5×10^{17} D/cm^2; (3) – 7.5×10^{17} D/cm^2; (4) – 1×10^{18} D/cm^2; (5) – 1.3×10^{18} D/cm^2. On the insert - Dependence of the nanohardness of ZrN coatings on the deuterium implantation dose.