

HOT-TARGET HIPIMS DEPOSITION OF W-FUZZ LAYERS*

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Nanostructuring of tungsten surface under the exposure to helium ion fluxes has been studied by a number of scientific groups since 2007 [1]. This effect was examined mainly in the context of helium accumulation, and the growth mechanism of such structures on the surface was investigated. In present work, porous tungsten coatings were deposited by magnetron deposition in He environment. The deposition was carried out in the HiPIMS mode with a frequency of 1 kHz and a pulse duration of 300 μ s. The tungsten target was thermally insulated from the water-cooled cathode. The working gas was helium. The pressure of the working gas was varied in the range $2\text{--}6 \times 10^{-2}$ Torr. The average discharge power was 1.5 kW. A bias voltage was applied to the sample. The sample temperature was measured with a thermocouple in a separate experiment. The sample temperature was varied by changing the distance between the sample and the target.

Since it takes some time for the sample temperature to reach the stable value, the fracture of coating reveals different stages of fuzzy structure growth depending on temperature (Fig. 1b). The thickness of the coating depends on the temperature of the sample during deposition—the lower the temperature, the denser the coating, the smaller the thickness (Fig. 1a). However, in the range 900–1200 K, a dendritic structure of the coating with various heights is formed. The sizes of individual fibers are from 10 to 100 nm. With a further increase in temperature, the fibers are enlarged into separate ribbon formations with a width of several microns (Fig. 1c).

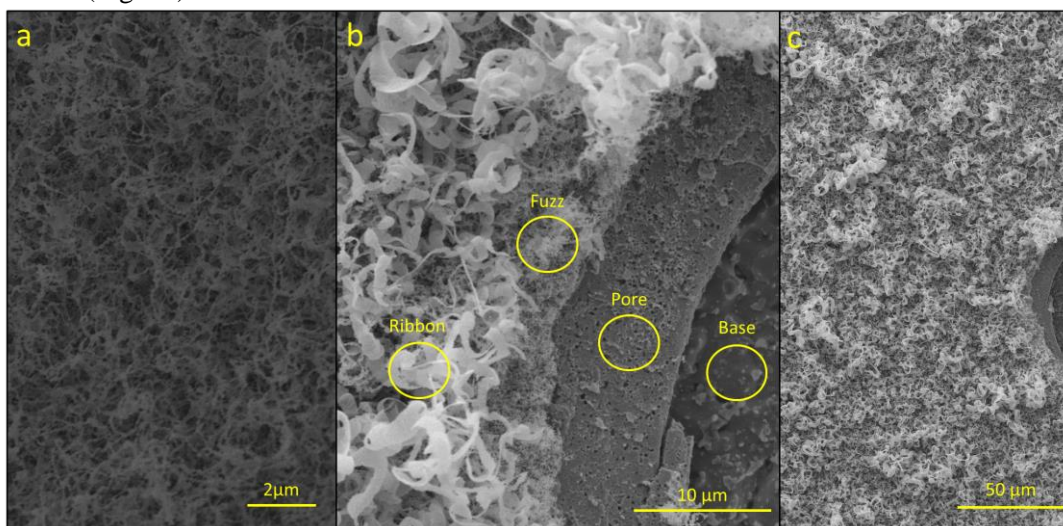


Fig.1. The structured coating deposited by HIPIMS method. a – classic tungsten-fuzz, b – different stages of fuzzy structure growth depending on temperature, c – separate ribbon formations of coating.

Such formations have not been previously reported in the literature devoted to the studies of tungsten structuring under the exposure to helium flux bombardment. Moreover, a number of works have shown that when He irradiation takes place at temperatures above 1200–1300 K, dendritic structures are not formed, and the surface remains smooth [2].

REFERENCES

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