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Tungsten, Carbon and Beryllium Film Interaction with Plasma Produced by Terawatt Laser System Irradiation

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A terawatt laser system (Tewalas), 360 ps pulse duration, 120 mJ pulse energy was used to produce plasma in a D_2 atmosphere in the vicinity of pure tungsten, carbon and beryllium films coated on graphite substrates. Tungsten, carbon and beryllium films with the thickness of 200-2500 nm were prepared using the originalThermionic Vacuum Arc method developed at the National Institute for Laser, Plasma and Radiation Physics. The method uses circular heated cathodes emitting high intensity electron beams capable to melt refractory materials. The plasma plume, produced by the laser pulses was investigated by a VUV spectrometer. The spectra were recorded in the 10-22 nm domain from successive pulses in the same sample locations. After laser irradiation, optical imaging, scanning electron microscopy and XPS studies revealed nanostructured films formation. The Raman scattering measurements on carbon films inferred the characteristic D and G modes awattof carbon in all samples while the specific peak at 1330 cm^{-1} corresponding to diamond was observed also. Nanohardness measurements using a nanoindenter gave values of 10-20 GPa, opening the possibility of using such materials as protective coating on a wide range of mechanical components, including the first wall of a fusion reactor.
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