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Periodic structures formation on beryllium, carbon, tungsten films mixed films by TW laser irradiation.

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Fusion devices based on thermonuclear reaction are intensely studied nowadays. A problem in study is the material composition of the first wall of the reaction chamber, erosion, deposition and fuel retention of the mixed layers produced during device operation. The high energy fluxes usually found in the tokamak reactor (10-100 MW/m^2) are simulated worldwide using ion and electron beams, hot plasmas and laser irradiation.

270 nm and 400 nm widths periodic structures were formed on surfaces made of Be-C, Be-W and C-W mixtures immersed in air and deuterium after irradiation by ultrashort high-power laser pulses with λ=800nm which were focused directly or at 0.3 mm above the samples surfaces. The periodic structures were organized into small patches of 1 to 2 microns in size.

The 200-500 nm thin films of Be-W, Be-C and C-W mixed layers were prepared by thermionic vacuum arc (TVA) method. The interaction occurs with single or multiple terawatt laser beam pulses as well as under the interaction with the plasma produced by laser irradiation in a gaseous environment. The high power terawatt laser system (TEWALAS) has 20-30 x 10^{-15} s pulse duration, 400-450 mJ pulse energy, 10 Hz repetition rate. Features not observed with longer (nanosecond) laser pulses were revealed on the irradiated surfaces. Periodic structures were observed to depend on the number of pulses and the buffer gas. The coatings were characterized before and after laser irradiation by: Scanning electron microscopy (SEM), Atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy

While higher laser fluency could lead to the nano-diamond crystals formation in the carbon containing mixtures, at values between 0.2-0.5 mJ/cm2, i.e. around the carbon ablation threshold could still produce an increase of the sp3 bonds percentage at the expenses of the sp2 bonds. Only a decrease of oxygen content could be noticed by in depth XPS investigations for Be and W containing deposits, while a weak cumulative effect through the increase of the sp3 percent could be assumed for the carbon containing samples (direct) irradiation.

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