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Femtosecond Laser Nanostructuring of Tungsten and Molybdenum

Femtosecond Laser Nanostructuring of Tungsten and Molybdenum

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Nanoscale transition metals and chemical compounds are based on them have a wide scope of industrial applications. Transition metals include a large number of elements that are significantly different from each other by chemical and physical characteristics. They are used in various fields of industry, science and technology. Nanostructuring of refractory metals and materials based on they allows to increase significantly the efficiency of their traditional use and develop new applications [1–3].

Surface processing of samples from tungsten and molybdenum was performed by radiation of femtosecond laser system TETA-10 with a Yb:KGW active medium. Parameters of laser radiation: wavelength is 1030 nm; pulse duration is 300 fs, energy is 0.15 mJ, repetition frequency is 10 kHz. The laser radiation has a linear polarization.

Femtosecond laser radiation may very effectively used for the surface nanostructuring of materials. But its extreme characteristics make it difficult the study of processes of formation of nanostructures. Typically, the process of laser nanostructuring is completed the formation of ripple pattern with the period of structures comparable to the wavelength of influencing radiation. This pattern is often registered and studied by researchers. Tungsten and molybdenum belong to the class of refractory metals and have high resistance to external influences. This property of refractory metals allowed a more detail study the scenario nanostructuring of their surface by means ultrashort laser pulses [4–6].

The results of our experiments allow distinguish three stages in a laser nanostructuring of refractory metals. First stage is the synthesis of surface nanostructures in the form of nanorods or nanospheres. Second stage is deposition of products of a laser ablation and forming the ripple pattern. Third stage is the thermal effect of laser-induced plasma plume which destroys formed nanostructures or sharpens them. The last stage may be excluded at the processing of materials in a cryogenic liquids such as liquid nitrogen. However, the thermal effect leads to the formation of the net-like system of nanostructures at femtosecond laser processing of tungsten in the air. Therefore we plan to further study the technological regimes and experimental schemes processing of refractory metals by means femtosecond laser radiation in order to determine the most effective possibility of their nanostructuring.

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