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PULSED LASER PLASMOTRONS

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A method of material processing not directly by laser beams but with the help of gas pulsed optical breakdown plasma is investigated. If the gas is chemically active the new approach to material surface treatment can be realized - laser plasma induced synthesis of different compounds.

High repetition rate TEA CO₂-laser with the energy of 2 J in microsecond pulses and repetition rate up to 300 Hz was used. The irradiated samples was positioned in chamber with various gases.

Surface nitration of Ti, Zr, Hf transition metals and same types of steel was performed by using of optical breakdown of gaseous N₂. Layers of nitrogen containing compounds with enhanced microhardness and thickness up to 40 μm were obtained. The influence of laser parameters, sample surface condition, N₂ pressure and presence of admixture oxygen on the synthesised compounds composition and properties were studied.

The optical breakdown plasma in the mixture of iron pentacarbonyl vapors and silane with argon was used to obtain iron and silicon thin films. It has been found that parameters of the film (thickness, adhesion, density, composition) depend on partial pressure and the kind of gases (reactant or buffer), as well as on the propagation modes of optical discharge. Films formed in silane-argon mixture consist of hydrogenated silicon Si:H. Hydrogen content in silicon films is as high as 10%, this being advantageous when using them in thin solar cells.

It is shown that multipulse laser irradiation of some insulator ceramic samples (TiO₂, ZrO₂, HfO₂) in an ammonia atmosphere, surface layers are synthesized exhibiting a complicated morphology and having a complex structure containing, beside metallic nitrides, nonstoichiometric oxygen-depleted oxides and oxinitrides. Such layers have a diminished sheet resistance, and display good conduction characteristics.

It is shown that pulsed laser plasmotron chemical action can be highly localized (within the irradiation spot area) and very efficient.