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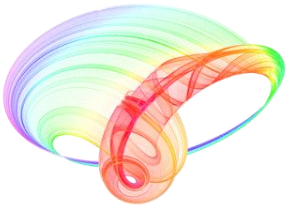

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Laser-induced periodic structure on Ti and Ti/Al thin films for photocatalytic application

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Modification of single titanium and complex titanium-aluminium samples by laser processing in the femtosecond time domain is unexplored field. This work included a study of the effects caused by changes in the composition and morphology of the compact Ti thin film and multilayer Ti/5x(Al/Ti) structure. Titanium and its oxides have specific physical, chemical and mechanical properties, such as high corrosion resistance, good stability, high strength and porosity. Titanium−oxide materials in different types and forms have shown great potential as ideal and powerful photocatalysts for various significant reactions due to their chemical stability, nontoxicity, and high reactivity. Laser surface modification allows production of active surface with formation of the desired oxide, creation of nano/micro textures and change wettability of the surface.
The samples were processed by focused an Yb:KGW laser beam with 1026 nm central wavelength, 170 fs pulse duration and repetition rate of 1 kHz. The laser-induced morphological and composition modifications have shown dependence on applied intensities and number of laser pulses. The formed surface nanostructures on the Ti and Ti/Al thin film surface (5x5 mm) are obtained in scanning regime. The results show an increase in surface roughness, formation of parallel periodic surface structures, appearance of hydrodynamic features and ablation of surface material. At low pulse energies range (not over 0.01 mJ) and effective 50 pulses, the two types of LIPSS can be observed: low and high spatial frequency LIPSS (HSFL and LSFL). The low spatial frequency LIPSS (LSFL), oriented perpendicular to the laser polarization with periods slightly lower than the irradiation wavelength, was typically formed. The laser-induced surface oxidation was analysed by Elastic Recoil Detection Analysis (ERDA) in the subsurface part of the investigated samples, which indicates formation Ti-oxide and mixture of Al- and Ti-oxide in the case of multilayer structure. Photocatalytic degradation rate on the laser irradiated surface of Ti and Ti/Al thin films was compared with unmodified samples. The rate of photo-degradation was associated with changes in structure of Ti-oxide and in increasing of surface roughness with formation of periodic structure.