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Surface area nanostructuring with LIPSS formation using femtosecond laser

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Surface nanostructuring techniques are commonly used for energy conversion systems such as electrochromic devices, dye-sensitized solar cells and PEM fuel cells, to increase the efficiency of the electrochemical processes by increasing the surface effective area. Femtosecond laser processing allows the formation of sub wavelength nanostructures, the so called laser induced periodic surface structures (LIPSS). Homogeneous LIPSS patterns, with periods as low as 100 nm, can be formed over extended surface areas and shaped by controlling the laser parameters.
In this work, TiO_2, WO_3 and B_4C thin films were prepared by reactive magnetron sputtering (RMS) and their surface was nanostructured using a commercial femtosecond Yb:KYW chirped-pulse-regenerative amplification laser system. The morphology and chemical composition of the films was analysed by scanning electron microscopy and electron probe microanalysis. Micro Raman spectroscopy and x-ray diffraction were used for structural characterization while the morphology and topography of the nanostructured surfaces were characterized by optical profilometry and atomic force microscopy.
Sub-micron LIPSS were formed on the surface of the thin films. The width and depth of the nanostructures depend on the laser power and laser scanning parameters. In the case of Boron Carbide films LIPSS with 100 to 400 nm width and 20 to 70 nm depth were formed leading to an increase of the surface area dependent of the laser power and related with the LIPSS size. Homogeneous LIPSS patterns were obtained over extended 3 by 1 mm on the crystalline boron carbide films.

Keywords
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thin film
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