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Highly-Uniform Thermochemical Laser-Induced Periodic Structures Formed by Femtosecond Laser Pulses

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Laser-induced periodic surface structures (LIPSS) is a remarkable phenomenon observed on surfaces of almost any materials under an impact of laser radiation with high intensity. LIPSS represent a periodic modulation of relief height and are formed due to the interference effects between incident light and scattered waves, which create an intensity pattern on the surface with periodicity and orientation defined by the parameters of irradiation, e. g. wavelength, polarization, angle of incidence, as well as properties of material and ambient environment [1]. At laser fluence under an ablation threshold, the regimes of thermochemical LIPSS based on a thermally stimulated reaction of oxidation were observed on surfaces of thin metals and amorphous semiconductors films with outstanding regularity and optical properties opening pathway for various applications including optical sensors, biophotonics, and solar light harvesting [2]. In this work we review our recent results on thermochemical LIPSS formation under impact of femtosecond laser pulses on Ti, Cr, Hf and semiconductors amorphous Si and Ge thin films. The sub-wavelength structures with morphology depending on the processing parameters and strategy of laser micromachining were revealed. The different physical mechanisms responsible for thermochemical LIPSS formation along with practical applications of obtained structures are discussed.

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