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Periodical structures induced by femtosecond laser on metals in air and liquid environments

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ABSTRACT

Ripples or laser-induced periodic surface structures (LIPSS) are obtained on metallic films (Cr, Ti, W) by femtosecond laser pulses working at both fundamental (775 nm) and frequency doubled (387 nm) wavelengths in air and liquid environments. The metallic samples were irradiated at normal incidence, in air and by immersing them in water (H₂O), ethanol (C₂H₅OH) or chloroform (CHCl₃). Different morphologies were observed after laser irradiation on the material surface, depending on material, environments and the laser irradiation parameters. We observed areas of ripples or nanostructures (NS) at both irradiation laser wavelengths in all environments used. The morphology of the formed structures was studied by Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM). The analysis of images obtained revealed two kinds of ripples: Low Spatial Frequency LIPSS (LSFL) with a periodicity of about 350 to 600 nm, and High Spatial Frequency LIPSS (HSFL) with a periodicity from about 50 to 200 nm. We found that the periods of the structures formed in liquids are generally several times smaller than those formed in air. When samples are processed in air with 387 nm laser wavelength, the periods are similar to those obtained in liquids at 775 nm. The formation mechanisms of ripples structures are discussed.

Keywords: femtosecond laser, liquids, metals, LIPSS.

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