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Application of laser-induced thermal emission for surface relief imaging

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Laser-induced thermal emission (LITE), generated by light-absorbing objects heated up to incandescent temperatures with nanosecond laser pulses of moderate power, is observed in the visible range of optical radiation spectrum. LITE is a kind of secondary emission which is sensitive to the structure of the irradiated surface layer. The techniques based on thermal emission observation are promising for diagnostics of surface roughness and temperature under laser processing, visualization of microinclusions in the subsurface region and porosity of porous carbons, as well as can be used to distinguish variations of such environment parameter as air pressure.

A Q-switched YAG:Nd laser (pulse duration τ = 20 ns, wavelength λ = 1064 nm) was used to excite LITE. The images of laser-irradiated surfaces were observed through a microscope with LOMO-8-0.20 object lens and K15x eyepiece lens. The snapshots with LITE were made in a single-shot laser regime.

The greyscale maps of time-integrated radiant exitance were calculated for different combinations of material parameters and for various peak and hole sizes. It was revealed that LITE local exitance and its kinetics depend on a shape and size of the elements forming surface roughness relief. Besides, the LITE characteristics are also sensitive to the variations of local thermal and optical parameters of the material of a surface layer at a depth of the order of the laser penetration depth and the temperature diffusion depth.

Topics

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Primary authors: ZELENSKA, Kateryna (Shizuoka University); Ms TKACH, Olga (Taras Shevchenko National University of Kyiv); Prof. ZELENSKY, Serge (Taras Shevchenko National University of Kyiv); KOLESNIK, Olexandr (Taras Shevchenko National University of Kyiv); AOKI, Toru (Shizuoka University)

Presenter: ZELENSKA, Kateryna (Shizuoka University)

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