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ABSTRACT: In sample microanalysis by laser ablation (LA), spatial resolution is determined by laser beam diffraction limits (of the order of a laser wavelength) and thermal diffusion of a deposited heating energy during laser pulse (proportional to the square root of pulse duration and matter diffusivity). Being limited by these laser beam features and those of heating energy, spatial resolution (a crater diameter) of ~1 µm was obtained with 4 ns laser pulses on 266 nm wavelength [1-2]. To improve spatial resolution of microanalysis, the application of lasers with the pulses of shorter durations (ps and fs) may be advised [3-5]. As another way to improve spatial resolution of microanalysis up to ~100 nm, one may advise LA with a highly localized laser field created by a tip near-field enhancement [6]. The experiments with ns laser pulses were made along with multi-parametric theoretical studies [7] based on one-temperature heating model.

In this work, the theoretical studies were extended on ultra-short laser pulses (ps or fs) to analyze the effect of pulse duration and matter properties (absorption coefficient, thermal conductivity and capacity) on the resulting temperature field spatial distribution T (t, x, y, z). A two-temperature model was applied for T (t, x, y, z) calculations. The results of these simulations are compared to temperature distributions for ns laser pulses. Discussion on advantages of ultra-short pulses application for LA with a tip near-field enhancement for consecutive chemical analysis with nanometric resolution will be presented.

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