Ferroelectric materials under the strong THz radiation

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In traditional memory devices the recording information speed is determined by the magnetization switching speed. The possibility of magnetic order parameter switching under the single femtosecond laser pulse action was already demonstrated. At present it is the most effective way control the medium at extremely short times. Application of the same technique to ferroelectric materials will allow to build new effective and non-volatile memory devices. However, the problem of ultrafast ferroelectric polarization switching is not solved yet. The reason is that ultrafast magnetization switching is determined by the spin-orbital and exchange interactions, but there are no the same mechanisms in ferroelectric materials. Today, there are several works that show the possibility of direct ferroelectrics soft mode excitation by optical or THz pulses. However, the polarization switching in these works was not achieved. Thus, the study of the ultrafast ferroelectric polarization switching is still an urgent task. Here we present the results of the strong sub-picosecond single THz pulse action on a lead germanate crystal doped with silicon. The transmission of a THz wave and the intensity of second harmonic generation in the time and spectral domains were measured, on the basis of which the dispersion of the absorption coefficient and cubic nonlinear susceptibility were calculated in the range of 0.5–2 THz. The presence of a region of fundamental absorption near the phonon modes, as well as a resonant enhancement of the cubic nonlinear susceptibility for two phonon modes Q_1=1.3 THz and Q_2=2 THz, was found. This work was supported by the Russian Science Foundation (grant No. 20-72-10178).