X-ray and THz generation from metal foil irradiated by laser pulses

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Powerful terahertz (THz) pulses can be used to excite non stationary states of matter via phonons, excitons, etc. We experimentally compare several methods to get efficient THz with femtosecond, 800 nm laser pulses driver, the generation in metal case has an advantage (over nonlinear crystals or plasma) of efficiency increase with TW laser power. While much of cutting-edge research in relativistic electrodynamics is currently focused on THz generation from metal foils driven by relativistic laser pulses, here, we show that some yet-to-be-solved problems in laser–matter interactions can be addressed by studying THz emission from metal foils at lower, nonrelativistic levels of laser intensities. We observed the efficiency 10^{-5} of THz generation, that is higher than predicted by known theories for the intensity of $10^{16} W/cm^2$. X-ray radiation from the same foil is analyzed. Characteristic $K\alpha$ line is sufficient for X-ray fs diagnostics of nonstationary states of matter, providing 10^8 photons/sr/pulse. An important issue is to refocus X-ray radiation on the sample for (THz) pump-probe study with almost parallel and narrow beam. For that purpose we develop a special polycapillary lens. This work is supported by RFBR grants (No. 18-02-40032, 20-21-00140).