Estimation of SUS plasma state using x-ray emission spectra in experiments with ultra-relativistic femtosecond laser pulses

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In this work we talk about application of high spectral resolution x-ray spectroscopy diadnostics in experiments with femtosecond laser pulses reached intensity on target 10^{22} W/cm^2. We report on recent experiment with the J-KAREN-P laser facility. One was aimed at efficient hard x-ray and coherent soft x-ray generation via high-order harmonics in pre-plasma of solid foil-targets. We observed x-ray radiation at the wavelength range $\lambda = 13 - 17$ Å emitted from both sides of stainless-steel foil-target at different parameter of laser pulses, various thickness of targets and geometry of experiments. The comparison of observed spectra of F-like and Ne-like Fe ions with results of kinetic modeling allowed to measure main parameters of plasma corona: ion composition, electron temperature and density. The comparison of plasma parameters measured in both cases: controlled fs-prepulse application and no fs-prepulse, demonstrated the absence of strong changes of plasma state. That means plasma parameters mostly depends on natural picosecond laser prepulse, but fs-prepulse variation at the time comparable with laser pulse duration becomes insignificant. We also made precise calibration of x-ray spectroscopy equipment and estimated the emittance of soft-x-ray source in absolute units for various experimental conditions.