Simulation of The Ionization Dynamics of Aluminum Irradiated by Intense Short-Pulse Lasers

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We present results from collisional-radiative simulation of the ionization dynamics of Al at near-solid density. Calculations were performed for a range of plasma and energetic electron parameters representative of those obtained from particle-in-cell simulations of the heating of Al by intense, short-pulse laser. Various pulse shapes with different durations– normal and oblique incidence- have been chosen while the intensity and the polarization of the laser beam were varied. Influences of the plasma density and of the initial electron temperature have also been taken under consideration.

We used the distorted wave approximation to output cross sections and rates for the atomic processes included into the model. They were compared with the *R*-matrix calculation results in order to provide a set of data that can be confidently applied. To this aim, the target energies and orbitals were calculated with the extended average level multi-configurational Dirac-Fock method in the general-purpose relativistic atomic structure package (GRASP), while for determining the collision strengths the Dirac Atomic R-matrix Code (DARC) is used.

The spectral data generated by collisional radiative model contain the detailed level population and the spectral lines emissivity. Energy levels, divided into superlevel blocks allow to investigate the influence of energetic electrons on the ionization dynamics of the Al and its emission.