Dynamics of levels population of sputtered particles in plasma

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Measurements of the intensity of radiation from sputtered atoms is one of the methods for definition of sputtering parameters, such as velocity distribution of sputtered species or their distribution over excited states. Corresponding experiments conducted on linear plasma devices, e.g. PSI-2 or PISCES allow to get insight on physics of impurities transport in plasma with parameters close to those of tokamak edge.

Spatial variation of radiation of sputtered atoms depends both on atomic processes responsible for excitation and photon emission and various geometry factors such as distribution of plasma temperature and density or distribution of sputtered particles over velocities and directions. In this work we apply a radiative-collision model giving full description of population of excited levels of sputtered atoms and their radiation to experimental results on molybdenum (Mo) sputtering in helium (He) plasma at the PSI-2 installation. Recently obtained data set on the crossections of electron impact excitation, deexcitation, ionization and spontanious emission including 800 excited levels of Mo is used [1]. Our calculations reproduce reasonably well the experimental results. One of the main features of the excited levels dynamics is a large number of levels having long, up to 10^{-4} s time scales. This eventually leads to a maximum in dependence of intensity on the distance from the target, located at approximately 1 cm for some lines, observed in the experiments.

The model presented in this work is a further improvement of a ”two-levels” model employed in earlier ERO code calculations [2]. The latter supposes that all the excited levels very quickly come to the equilibrium values except of two levels responsible for radiation of a specific line. Shortcomings of this approximation comparing to the presented one are discussed.

References

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