Relaxation of the plasma in targets after ionization by a fast heavy ion

Morozov I.V., Norman G.E., Skobelev I.Yu.

IHED RAS

Interaction of fast heavy ions with solid and porous targets leads to irradiation of X-ray spectrum lines which can be measured experimentally [1]. However, available experimental results cannot be explained only due to the relaxation of an isolated excited ion but it is required to consider surrounding plasma which appears after ionization of the media by the electric field of a projectile multiply charged ion. To do that it is needed to study dynamics of the plasma for the times corresponding to irradiation of the spectrum lines which are as long as 1-10 fs. In particular the following issues should be considered: decreasing of the free electron number density due to diffusion of the electrons away from the track area, equilibration of the velocity distribution function for electrons to the Maxwell one, time scale of the decay of ionic crystal structure, recombination rate in the plasma.

The plasma parameters under study are $n_e \sim 10^{23}$ cm^{-3} for the electron number density and T_e = 10-100 eV for the initial electron temperature. This corresponds to the essentially nonideal (strongly coupled) plasma with the nonideality parameter in the range $\Gamma = (4\pi n_e/3)^{1/3} e^2/(kT) = 0.1 - 1$. In the present work relaxation processes in such a plasma are studied by the method of molecular dynamics simulations [2]. The obtained results confirm the applicability of the plasma model to interpretation of the measured irradiation of the targets. In the future these results can be used to a construct a hydrodynamics model of the track production and modification (strength loss) of the solid targets due to long-duration irradiation by the heavy ion beam.

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2. *Morozov I.V., Norman G.E.* Collisions and plasma waves in nonideal plasmas // Journal of Experimental and Theoretical Physics (JETP), 2005, v. 100, No. 2, pp. 370-384.