Modeling the dynamics of radiating micropinch discharges

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The sources of radiation in hard ultraviolet range (wavelength 10–15 nm) are necessary for manufacture of the new generation of microchips (with size ~ 30 nm). One of ways of their creation is the generation of plasma with temperature 20–50 eV in z–pinch discharges. The modeling of given discharges is carried out in the present work.

Dynamics of acceleration and compression on symmetry axes of the plasma cylinder (radius 0.1–0.8 cm) of current pulses ~ 50 kA with rise time 50–100 ns is considered. The numerical modeling is carried out in one–dimensional approximation of magnetic radiating gas dynamics. The power supply is simulated by a RLC–circuit closed on a plasma shell. In calculation the real thermodynamic, transport and optical properties of plasma are used. Ionization composition of plasma and population of levels are calculated on a basis of collisional-radiative model. The radiation transfer is described in «forward–reverse» approximation by angles and multigroup by photon energy. The specific calculations are carried out for z–pinch in xenon (initial energy E_0 = 10–30 J, maximal current 30–100 kA, density ~ 10^{-6} g/cm^3). The detailed picture of dynamics of processes in the discharges is investigated and the efficiency of energy transformation in radiation is determined. It is shown, that the given discharges are intensive sources of radiation in the hard ultraviolet range of spectrum.