Capillary Discharge - a Way for Recombination XUV Laser?

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Abstracts *The study of capillary discharge taking into account the effect of wall ablation is reported. Results of electrical diagnostics and gated spectra measurements are compared with the results of computer simulations. We have approved that the ablation of capillary wall at high currents strongly influences the pinch dynamics. The most critical parameters for lasing are the peak value of electron temperature at the time of pinch contraction on the axis and the rate of temperature decrease during pinch decay. The possibility to achieve the necessary for lasing parameters in the experiment is discussed.*

Capillary pinch discharge has been demonstrated as a very successful way of pumping of compact and efficient extreme ultraviolet EUV lasers. Namely, pinching plasma column inside an argon-filled capillary has been shown to be very efficient way to achieve lasing at 46.9 nm. In this case, the active medium was formed by collisionaly excited neon-like argon ions Ar^{8+} created during the pinch compression stage [1, 2].

There is a significant interest in extending capillary discharge pumped lasers to shorter wavelengths. A recombination-pumping scheme leading to a population inversion of the Balmer alpha transitions of low *Z*-elements is, in principle, an alternative. In this scheme, the primary pumping process is three-body collision recombination, which takes place in the nonstationary undercooled plasma, created during the pinch expansion stage.

We have developed a computer model of active medium creation. The capillary discharge dynamics was modelled by means of hydrodynamic NPINCH code. The radiative properties of Z-pinch plasma were described using the kinetic code FLYCHK as a postprocessor [3]. Efficient amplification of spontaneous emission of Balmer alpha was predicted in nonablating capillary. But in the experiments [4-7] lasing was not observed. Wall ablation may be a serious obstacle to the way to capillary recombination pumping.

Here we report the study of capillary discharge taking into account the effect of wall ablation.

We have approved that the ablation of capillary wall at high currents strongly influences the pinch dynamics. The ablated material has a serious cooling effect; the electron temperature on the axis becomes lower than in the case without wall ablation. At the same time, the ablated material obstructs the rate of plasma cooling. Results of electrical diagnostics and gated spectra measurements are compared with the results of modified computer model.

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