Analysis of initial stage of capillary discharge using numerical simulation

M.Timshina[1], S.Eliseev[2], N.Kalinin[1], V. Burtsev[1], A. Samokhvalov[3], K. Sergushichev[4], A. Smirnov[4], D. Belsky[2], M. Letunovskaya[2]

[1] *Ioffe Physical Technical Institute, Russian Academy of Science, St.Petersburg, Russia*

[2] *«Burtsev laboratory» limited company, St.Petersburg, Russia*

[3]*ITMO University, St. Petersburg, Russia*

[4]*Saint-Petersburg Electrotechnical University "LETI", Saint-Petersburg, Russia*

Nowadays capillary discharge is considered as the main way to create compact sources of EUV and soft X-ray radiation. Radiation in this range with such discharge is generated at the stage of magnetic plasma compression, when the current flowing through the system reaches values of the order of several kiloamperes. The initial conditions for the flow of such current are created by the so-called sliding discharge. In addition to pre-ionization, the role of such discharge is in stabilization during compression stage [1] and potential X-ray generation during the transition from a sliding discharge to a high-current one [2]. A complete picture of the physical processes that accompany the transition is not yet available. Consistent numerical modeling can significantly clarify the situation. We present the results of a numerical study of a sliding discharge at low pressures and applied voltages with nanosecond durations and amplitudes of several kilovolts in a long dielectric tube of small radius. The propagation dynamics of the sliding discharge along the capillary tube was reproduced, the role of the transverse field on the dynamics of the whole capillary discharge was evaluated, the values of propagation speed and degree of ionization were analyzed depending on different pressures and pulse parameters.

[1] J. Szasz, M. Kiss, I. Santa, S. Szatmari, S. V. Kukhlevsky, "Magnetoelectric Confinement and stabilization of Z Pinch in a Soft–x-Ray Ar+8 Laser", *Phys. Rev. Lett.* ,110, 2013.

[2] V. A. Burtsev, V. V. Zabrodskii, N. V. Kalinin, E. P. Bol'shakov, "Electromagnetic radiation sources based on a low-inductive extended z-discharge," *Technical Physics*, 58(2), 192-199, 2013.