Radiative characteristics of prebreakdown stage of a high current surface discharge

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In experiments [1, 2] on the study of the surface discharge of ferrite was detected the presence of X-ray radiation (from the cathode to the anode) in the pre-breakdown stage (in the first nanosecond from the time of application of the voltage), when the breakdown of the ferrite surface did not occur yet. The discharge of the surface of the ferrite was carried out on BIN generator with maximum current of 270 kA and a rise time of 80 ns at a voltage on the object up to 300 kV. The experiments were carried out in a vacuum chamber at a pressure not exceeding 10–4 torr. The applied voltage and current through the load were recorded in each shot. As a load, (Ni-Zn) Fe2O4 ferrite M400 HH was used. The width and thickness were 20 and 8 mm, respectively, and the length was varied from 10 to 80 mm. A calibrated diamond diode AXUVH5S, sensitive to photons with energies greater than 10 eV, was used to record the radiated energy. Also, various filters were applied to the diodes to estimate the spectral composition of the radiation.

The dependence of the radiated energy on the length of the ferrite indicates the induced nature of the observed radiation — a nonlinear increase in the signal intensity with increasing length of the ferrite was recorded. The dependences of the radiated energy on the angle and the distance from the radiation source indicate the coherent nature of the observed radiation.

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References

1. I.N. Tilikin, S.N. Tskhai, T.A. Shelkovenko, S.Yu. Savinov, S.A. Pikuz, Generation of Intense UV Radiation during High-Current Breakdown over a Ferrite Surface, Plasma Physics Reports, V. 44, N. 6, pp. 600–604, 2018.
2. I.N. Tilikin, S. N. Tzhai, T. A. Shelkovenko, S. Yu. Savinov, S. A. Pikuz, A. R. Mingaleev. A Pulsed, High Intensity Source of XUV Radiation Based on Ferrite Surface Breakdown at High Current, IEEE Transactions on Plasma Science, V. 46, Iss. 11, 2018.