ON THE characteristic FEATURES OF THE STRUCTURE OF CURRENT MICROCHANNELS formING IN ATMOSPHERIC DISCHARGE

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The complicated microchannel structure of the extended atmospheric discharge current near the electrodes and in the discharge gap, observed by integrated methods [1], and the similarity of plasma formation dynamics near the high-voltage electrode with comparable field distributions at different scales of the discharge gap [2] were noted earlier.

Recent studies of the structure of emerging breakdown channels in a strong nonuniform field at atmospheric pressure with temporal resolution show [3] that structures with a micron spatial scale and high electron density are formed at the very beginning of the breakdown development [4]. At this point, a significant current flows through the discharge gap. There is a complex spatial character of the growth of microchannels: a change in the direction of growth, branching, closure, etc. on a longitudinal scale comparable to the transverse size of the channels. With a relatively long lifetime of the formed microchannels, up to the main stage of the discharge, at the early stage of their formation, on a much smaller time scale, effects are possible that are related by the spatial arrangement of the individual microchannels. So, the closure of several nearly located microchannels with a length of several hundred microns can be considered as switching of several conductors, which are long lines in the picosecond time range.

The paper discusses possible scenarios of “electrical” obtaining potentials higher than those applied in the nascent discharge due to the transformation of the applied voltage in the evolving structure of current microchannels. Such a local “voltage multiplication” can be one of the mechanisms for the occurrence of high-energy radiation (with quantum energy significantly higher than the applied voltage) in the initial phase of a high-voltage atmospheric discharge [5, 6].

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References

1. Oginov A.V., Rodionov A.A., Shpakov K.V. Book of Abstracts of XLII International Conference on Plasma Physics and CF, February 9 – 13, 2015, Zvenigorod, p. 237.
2. Agafonov A.V., Baidin I.S., Oginov A.V., Parkevich E.V., Rodionov A.A., Shpakov K.V. Book of Abstracts of XLV International Conference on Plasma Physics and CF, April 2 – 6, 2018, Zvenigorod, p. 240.
3. E.V. Parkevich, A.I. Khirianova, A.V. Agavonov, S.I. Tkachenko, A.R. Mingaleev, T.A. Shelkovenko, A.V. Oginov, S.A. Pikuz. J. Exp. Theor. Phys., 2018, Vol. 126, No. 3, pp. 422–429.
4. Medvedev M.A., Parkevich E.V., Hit’ko M.A., Khirianova A.I., Tkachenko S.I., Agafonov A.V., Oginov A.V., T.A. Shelkovenko, S.A. Pikuz. Book of Abstracts of XLV International Conference on Plasma Physics and CF, April 2 – 6, 2018, Zvenigorod, p. 222.
5. A.V. Agafonov, I.S. Baidin, A.V. Oginov, A.A. Rodionov, and K.V. Shpakov. Proc. of Int. Symp. Topical Problems of Nonlinear Wave Physics (NWP-2017), 22 – 28 July, 2017, Moscow–St. Petersburg, Russia, p. 133.
6. A.V. Agafonov, A.V. Oginov, A.A. Rodionov, V.A. Ryabov, V.A. Chechin, K.V. Shpakov. 2018, https://arxiv.org/abs/1807.07675.