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RUNAWAY ELECTRONS, DISPLACEMENT CURRENTS, AND DISCHARGE DEVELOPMENT IN A QUASI-HOMOGENEOUS ELECTRIC FIELD*

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Interest in the study of discharges in a homogeneous electric field is due to their use, for example, in switches. At the same time, such discharges are interested from a scientific point of view. In particular, it concerns the generation of runaway electrons (REs). They provide conditions for the ignition of the discharge in diffuse form. Thanks to the decades of intensive studies in this field, the conditions for the transition of electrons into runaway mode are defined [1–3]. However, specific processes in the discharge still require a detailed study. The success of such studies depends on progress in the development of measuring equipment and the emergence of new methods.

Experimental studies of the generation of REs during the formation of a nanosecond discharge in gaps with an electric field strength distribution close to homogeneous, filled with helium and nitrogen at different pressures, have been carried out. The experiments were carried out using high-speed recording methods (streak camera, four-channel ICCD camera), as well as using an original method based on measuring the displacement current caused by the appearance and formation of a streamer. This made it possible to study RE generation with reference to the dynamics of streamer development. It was possible for the first time in the experiment to accurately determine the instant of RE generation relative to the development of ionization waves in a flat gap filled with nitrogen at a pressure of 300 kPa.

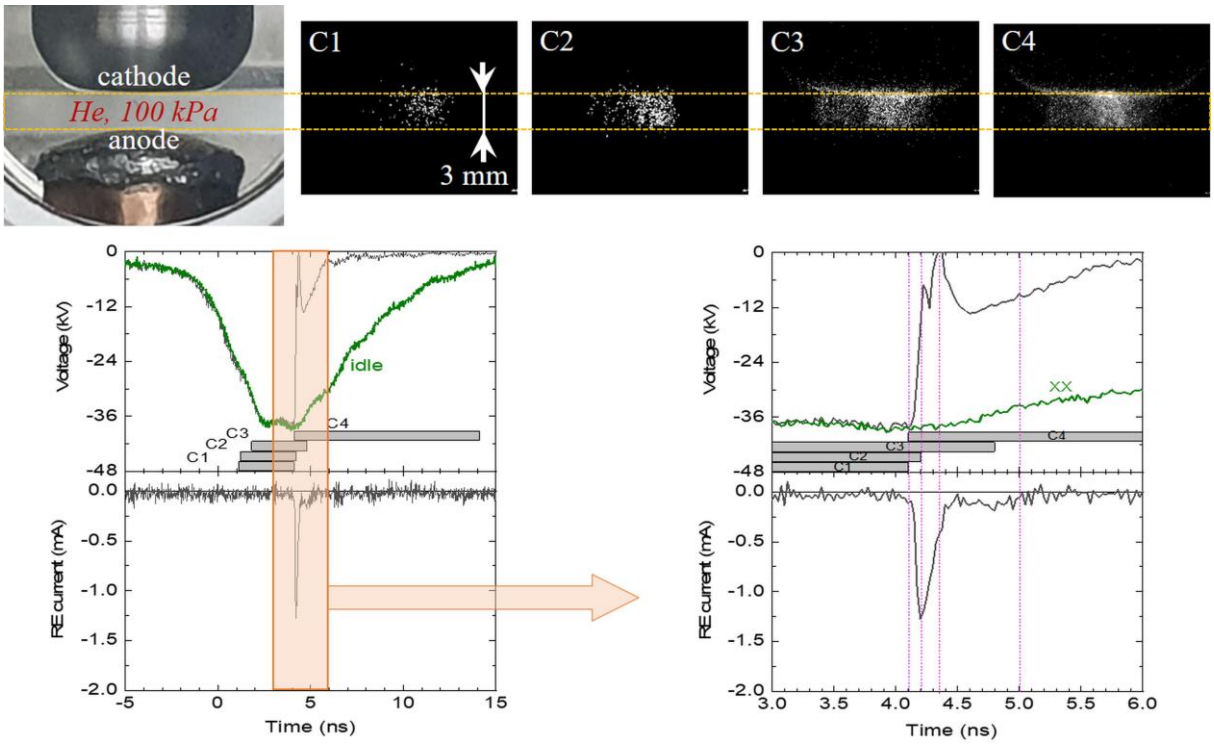

Fig.1. ICCD images of the discharge formation in helium at a pressure of 100 kPa and corresponding waveforms of voltage and runaway electron current. Rectangles show the exposure duration of the ICCD camera channels (C1–C4).

REFERENCES

[1] A.V. Gurevich, "On the theory of runaway electrons," Sov. Phys., vol.12, Article Number 904, 1961.

[2] L.P. Babich, High-energy phenomena in electric discharges in dense gases, Arlington, VA: Futurepast, 2003.

[3] V.F. Tarasenko, Runaway Electrons Preionized Diffuse Discharges, New York, Nova Science Publishers, Inc., 2014.

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