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P5.3010 Theoretical and experimental study of THz discharge threshold in various gases.

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In spite of the well-studied microwave discharge and laser, the discharge in the beams of the THz frequency band remains practically unexplored, including the gas breakdown threshold. Nowadays, there is a significant progress in the study of the THz discharge, associated primarily with the development of sources of the high-power coherent radiation in the terahertz and sub-terahertz range – gyrotrons and free electron lasers. The result of theoretical and experimental research of breakdown by powerful THz and subTHz radiation of gyrotron in various gases (Ar, Kr, Xe, N2, O2, Air) are presented in this work.
Experimental data were carried out in two setups. In both cases focused beam of THz emission used. In the first setup heating radiation were provided by gyrotron working in pulsed regime and generating radiation with a frequency of 670 GHz with power of 40 kW and maximum radiation intensity 10 MW/cm^2. In the second setup we used gyrotron with 250 GHz radiation frequency with power up to 250 kW and maximum intensity 5MW/cm^2. Discharge was studied in various gases (both for noble and molecular) in pressure range from 1 to 1500 Torr.
Calculation of breakdown threshold in heavy gases were based on Raizer discharge theory [1]. So we assumed that intensity of electrical field does not affect on electron diffusion and determined only by gas pressure. Calculation of breakdown electrical field for molecular gases (Air, N2) provided by using previous measured and calculated values of ionization frequency and diffusion coefficient which were carried out for static electric fields [2] by replacing it to effective electric field. In calculation we supposed that electrons were heated by numerous collisions. In case of electronegative gases the electron detachment were also taken into account. In conclusion the experimental and theoretical results were compared.

1. A. I. Vyskrebentsev, Yu. P. Raizer, Journal of Applied Mechanics and Technical Physics, 14, I, pp 32-38 (1973).
2. K.H. Wagner ," Ionization, Electron-Attachment, - Detachment, and Charge-Transfer in Oxygen and Air", Z. Physik 241,258-270 (1971)

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