

SUPERSHORT AVALANCHE ELECTRON BEAMS AND X-RAY IN HIGH-PRESSURE NANOSECOND DISCHARGES

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Abstract. Since 2003, an interest to investigation of e-beams generation in gas-filled diodes with high pressures has been rekindled. In 2005, the advanced recording methods of electron beams and the use of digital oscilloscopes with wide bandwidth provided the measurements of the beam current duration with time resolution of ~ 100 ps. In this paper, the recent measurement results on duration and amplitude of a beam, generated at a nanosecond discharge in different gases have been summarized (Tarasenko et al. 2005, Baksht et al. 2007, Tarasenko et al. 2008). Voltage pulses ~ 25 , ~ 150 and ~ 250 kV in amplitude were applied to the gas gap with inhomogeneous electric field. It is presented that the current of supershort avalanche electrons beam (SAEB) recording through a area with a small diameter the pulse duration behind a foil from the gas diode with air at atmospheric pressure is no more than 90 ps. For recording, the pulse shape it is necessary to use a small-sized coaxial collector, loaded to a high-frequency cable, and the same collector is used for taking the charge density distribution over the foil surface in order to determine the SAEB amplitude. The electron distribution over the foil section should be compared with a per pulse distribution. In these experiments, we have compared the distributions obtained per pulse on a RF-3 and luminophore films, placed behind a foil. Besides that, intensity distribution of X-ray radiation at the gas diode output was recorded by using a multi-channel detection device based on microstrip arsenide-gallium detectors of ionizing radiation. An analysis of those data shows that at the beam current duration (FWHM) of ~ 90 ps the beam current amplitude behind the $10\text{-}\mu\text{m}$ thickness Al-foil at atmospheric pressure of air is ~ 50 A.

Discharge formation and SAEB generation in sulfur hexafluoride and xenon at pressure of 0.01-2.5 atm and helium of 10^{-4} -12 atm have been investigated. The beam of runaway electrons behind $45\text{ }\mu\text{m}$ Al-Be foil was observed at sulfur hexafluoride and xenon pressure up to 2 atm. It was found that the SAEB duration (FWHM) increased with sulfur hexafluoride pressure in the range 1-2 atm. Spectra of a diffuse and contracted discharges in sulfur hexafluoride are presented. Waveforms of the electrons beams generated in helium at pressure 10^{-4} -12 atm were registered. Therewith the electrons beam in helium at $p = 12$ atm was obtained for the first time. Complex dependence of the electrons beam current amplitude from helium pressure was obtained. Three peaks of the current were observed at pressure 0.01, ~ 0.07 and ~ 3 atm.

References

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