RUNAWAY ELECTRONS PREIONIZED DIFFUSE DISCHARGES AT HIGH PRESSURE

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Breakdown of the gaps with a non-uniform electric field filled with nitrogen and air as well as with other gases under high-voltage nanosecond pulses was investigated. It is shown that conditions of obtaining a diffuse discharge without a source of additional ionization are extended at the voltage pulse duration decreasing. A volume discharge is formed due to the gap pre-ionization by runaway electrons and X-ray quanta. At a negative polarity of the electrode with a small radius of curvature, a volume (diffuse) discharge formation is determined by pre-ionization with runaway electrons which are generated due to the electric field amplification near the cathode and in the gap. At a positive polarity of the electrode with a small radius of curvature, the X-ray radiation, generated at the runaway electrons braking at the anode and in the gap, is of great importance in a volume discharge formation.

A runaway electrons preionized diffuse discharge (REP DD) has two characteristic stages. In the first stage, the ionization wave overlaps the gap during a fraction of a second. The discharge current is determined by the conductivity current in the dense plasma of the ionization wave and the displacement current in the remaining part of the gap. The second stage of the discharge can be related to the anomalous glow discharge with a high specific input power. During the second stage, the gap voltage decreases and the cathode spots formed as a result of explosive electron emission can participate in the electron emission from the cathode. At the increase of the voltage pulse duration and specific input power, the REP DD transforms into a spark discharge form.

A REP DD is easily realized in various gases and at different pressures; see [1] and references in [1]. At pressure decrease was obtained the anode electrons beam current to rise (up to ~2 kA/cm^2 in helium). At the REP DD, the anode is influenced by the plasma of a dense nanosecond discharge with the specific input power up to hundreds of megawatt per a cubic centimeter, by the electrons beam, shock wave and optical radiation from discharge plasma of various spectral ranges, including UV and VUV. This allows forecasting the REP DD application for modification and cleaning of metal and dielectric surfaces. The REP DD is promising as well for creation of the VUV-range excilamps with a high radiation power in a pulse. REP DD was use for pumping different gas lasers.

1. E.Kh. Baksht, et al. Runaway – electron – preionized diffuse discharge at atmospheric pressure and its application. // J. Phys. D.: Appl. Phys. 2009. Vol. 42. 185201. 9 pp.