METHODICS FOR ELECTRICAL DIAGNOSTIC OF THE PLASMA JET FORMED IN THE LOW-CURRENT PLASMATRON*

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Currently, plasma jets based on the atmospheric-pressure discharges are attracting increasable attention [1–3]. Frequently, the gas-discharge system for obtaining a plasma jet using the discharge in a gas flow are called a plasmatron. The electrodes of plasmatron are configured to allowing the gas to flow through the discharge region [1–4]. Thus, the heated flow of weakly ionized gas, so-called “plasma jet”, forms in the plasmatron nozzle [1–4].

This paper deals with the investigations of the plasma jet generated by using the atmospheric-pressure glow discharge in a vortex airflow with the electrode configuration corresponding to coaxial plasmatron. The discharge is supplied from the high-voltage DC voltage source. The ballast resistor is used for limiting discharge current at level less than 0.2 A. The air mass flow rate is varied from 0.1 g/s up to 0.3 gm/s. In these conditions, the mainly part of a total discharge current in plasmatron flows via the constricted positive column of the glow discharge and only a small fraction of electrical current is flowing through the jet volume.

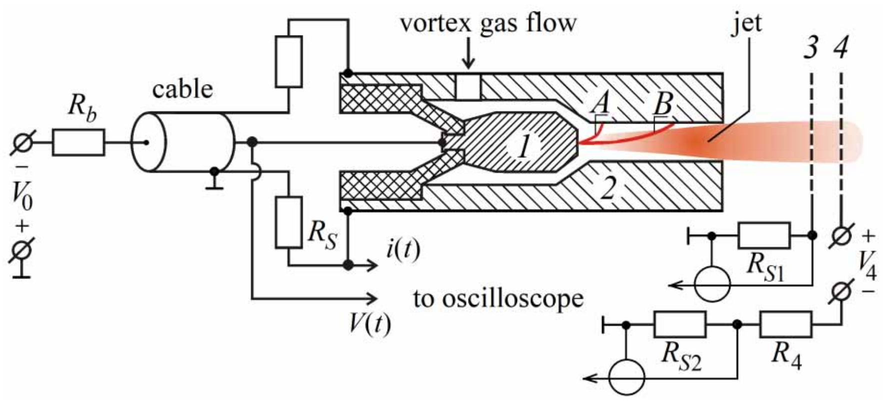

Fig. 1. Circuit of the experimental arrangement for diagnostic of the plasma jet. The discharge is sustained between the cathode of plasmatron 1 and the grounded anode 2 (a length of the plasmatron nozzle l = 20 mm, an inner diameter of the nozzle D = 5 mm). The system of additional diagnostically electrodes *3* and *4* are used to collect the currents flows through the jet volume. A, B – the positions of positive column (schematically). A typical DC voltage $V_0 = (3 – 5)$ kV, $V_4 \leq 3$ kV, $R_b = (20 – 42)$ kΩ, R_4 = 100 kΩ. The discharge burning voltage $V(t)$ is measured by the TDS-1012B oscilloscope with the high-voltage probe. The low-inductance shunts R_S = 1 Ω, R_{S1} = 1 kΩ and R_{S2} = 10 kΩ are used for the current signals measurement.

In the experiments the currents in the system of diagnostic electrodes is measured. The obtained data allow to concluding that the electrical current flowing through the jet volume forms due to electrons that can drifted from the discharge plasma region. It shown that the jet current magnitude is determined by the gas flow rate, by the discharge channel position and by the characteristics of the discharge in the plasmatron. The methodic for estimate the electron density in the jet volume has been proposed. Based on experimental data, the estimated value of the electron density in the jet is not less 10^9 cm^{-3}. At such value of electron density, the electric field distortion by the space charge of electrons can lead to the current self-limitation through the jet.

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