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GENERATION OF NITROGEN OXIDES MOLECULES IN THE PLASMA OF ATMOSPHERIC PRESSURE GLOW DISCHARGE IN AIRFLOW*

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The paper deals with the investigations of nitrogen oxide production in a column area of low-current glow-type discharge in airflow at atmospheric pressure. When the gas flows through the discharge plasma area, a luminous region, which is often referred to as a plasma jet, forms at the outlet of electrode system [1–4]. The jet contains the charged and chemically activated particles, so a great variety of the jets applications can be provided [1–6]. The special attention is payed to the biomedical applications [2, 5, 6], since the nitrogen oxides and the other active particles are available in the jet. For example, nitric monoxide is used in inhalation therapy as far as it has a relaxing effect on the blood vessels and for disinfection of wounds and skin wound healing [5, 6].

The electrode configuration of proposed gas discharge system (fig 1.) correspond to the non-steady-state coaxial plasmatron described in [1, 4].

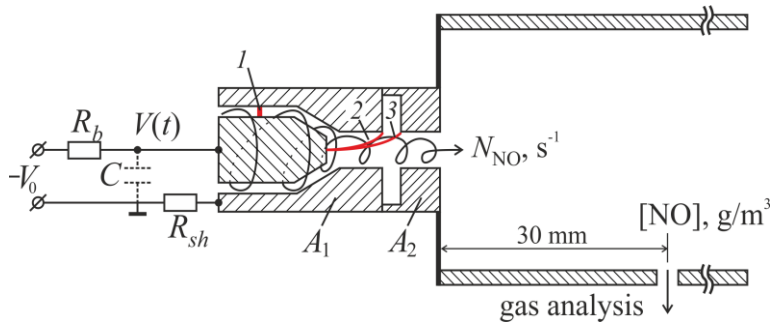

Fig. 1. Simplified circuit of experimental setup for NO_x production based on non-steady state plasmatron. 1 – position of the first breakdown, 2, 3 – schematic positions of positive column of glow discharge, A_1, A_2 – anodes of plasmatron, $V(t)$ – discharge burning voltage, V_0 – power supply voltage, R_b – ballast resistor, R_{sh} – shunt resistor for current measurement.

The glow-like discharge in plasmatron have been investigated using oscillography and CCD camera photography. The waveforms of the discharge burning voltage and the discharge current are obtained. The concentration of NO_x molecules in the produced gas flow are measured using gas analysis system.

It is shown, that the positive column of discharge in a gas flow is sustained in a constricted mode with a typical current density from 50 to 120 A/cm^2 and with the electron density up to 2×10^{14} cm^{-3}. The gas temperature in the plasma column of glow discharge is estimated as (3000–3600) K. In spite of a rather high gas temperature, the plasma is still nonequilibrium. The main channel of the nitric oxide production is associated with the interaction of vibrational excited nitrogen with atomic oxygen. The described conditions provide a total production rate of NO and NO_2 molecules from the plasma column up to $N_{NO} = 3\times10^{19}$ 1/s with the average energetic cost per one molecule of about 50 eV and less.

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