Radio Frequency Plasma Slit Jet as Novel AtmosphericPressure Plasma Source

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The properties of highfrequency discharges strongly depend on the type of plasma excitation and agenerator and a matching unit are their important part. Typically, atmosphericpressure plasma jets are based on the capacitive coupling. The models of RFdischarges with capacitive coupling discuss the spatial distribution of the electricfield E while the magnetic componentis neglected. The inductively coupled plasma is characterized by ahigh-frequency electromagnetic (EM) field with prevailing intensity of themagnetic component (H typicallyreaches 10^3 – 10^4 A/m) and low intensity of the electricfield E (typically 10^2V/m). However, here introduced RF plasma slit jet (PSJ)operating in argon is based on different principles generating an EM field withhigh intensity of both the electric and magnetic components. Plasma generationand regulation of the field intensities is achieved through special elementsintegrated in the plasma jet, periodic deceleration structures consisting ofvarying combinations of inductors with specially designed geometry and winding.Since the deceleration structures are part of the electric circuit fitteddirectly into the body of the PSJ they function also as resonance elements andthe inductor coil serves as the discharge electrode. The advantage of thedescribed configuration consists in the integration of the matching unit intothe jet body and possibility to achieve a wide (150-300 mm) active plasma jet. Asimplified numerical model of the spatial distribution of the electric andmagnetic fields inside the RF PSJ revealed a unique distribution of the EMfield in the region of the electrodes. The “active” area of the jet showed similarelectric field intensity as in the capacitive coupled RF plasma jets but theintensity of the magnetic component Hreached values in the order of 10^3 A/m. The plasma slit jet was experimentallyinvestigated by fast video imaging and optical emission spectroscopy.