A STEADY-STATE INTERELECTRODE MICROWAVE GLOW DISCHARGE IN AN ATMOSPHERIC PRESSURE Ar FLOW

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In this work, we present both experimental and theoretical study of spatio-temporal structure and plasma parameters of an interelectrode microwave discharge in atmospheric pressure argon flow. The discharge was induced in a coaxial designed cylindrical chamber with rod-like electrodes inside it. Such discharge device is used as a cold plasma jet source (plasma torch) for the purposes of surface plasma modification. The plasma torch is a cylindrical discharge chamber with an inner diameter of 2.5 cm, containing 6 rod electrodes of 4 mm in diameter with rounded ends. The electrodes are spaced from the chamber wall by 2 mm and arranged parallel to each other to form a regular hexagon in cross section (MicroPlaster-type configuration). Ar of high purity (99.998%) was used as a plasma-forming gas with the flow rate in the range up to several standard liters per minute. After the gas was supplied to the torch and the magnetron generation was started, the discharge was initiated by means of "seed" ionization when a tip of a thin metal wire was introduced into the interelectrode gap. As a result, bright steady-state discharge channels of glow type are formed between the ends of the electrodes and the inner wall of the discharge chamber close to the torch outlet. The distinct filamentation of the discharge channel was observed near the end of the rod electrodes. Moreover, dendritic fractal character of spatial microstructure of the discharge channel was found out.

Plasma-chemical model was used to estimate discharge plasma parameters. A mechanism for the formation of a self-similar spatial structure of the discharge channel was proposed which is in ionization process instability in the avalanche stage. From numerical simulations it was obtained that atmospheric-pressure microwave glow discharge plasma has a Maxwellian distribution for electrons. The electron loss caused by recombination and significantly exceeds diffusion losses characterized by ambipolar diffusion. Estimates show that convective heat removal from the plasma channel is significantly less than the input power. This indicates a heat-conducting mechanism.

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