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CHARACTERISTICS OF RF DISCHARGE WITH LIQUID ELECTRODES *)

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Nonequilibrium low-temperature plasmas of electrical discharge in liquids between solid and liquid electrodes at atmospheric pressure as well as between liquid electrodes, have attracted the attention of researchers due to their wide applications related to environmental protection and medicine. Generating intense UV radiation, shock waves and active radicals, electrical discharges with liquid electrodes are particularly suitable for decontamination, sterilization, cleaning and polishing of metals and alloys [1, 2].

The paper presents the results of experimental and theoretical studies of RF discharge with electrolytic electrodes at both atmospheric and reduced pressure in a wide range of discharge parameters and various configurations of discharge devices with different compositions and electrolyte concentrations.

As a result of experimental studies, the basic patterns of the formation of current-voltage characteristics, current and voltage fluctuations, structures, distributions of potential and electric field strength, current densities at the electrodes, optical inhomogeneities of convective gas flows, deformations of the liquid media surface, spatial distributions of temperatures on the surface of liquids and solids are established. It has been established that in the RF electrical discharges with liquid electrodes the electron concentration n_e is in range $10^{15} - 10^{16}$ sm^{-3}, electron temperature T_e is in range $1.1 - 1.4$ eV, vibrational temperature T_v and rotational temperature T_r is from 900 to 4800 K.

A generalized physical and mathematical model of a multiphase “liquid-gas-plasma” medium under conditions of burning RF discharges with liquid electrodes has been developed. Simplified models of electric discharges of RF current were studied, which made it possible to establish and theoretically substantiate the presence of layers of positive and negative charges in the structure of the discharges, and to estimate the magnitude of the electric field strength at the liquid-gas interface of the jet electrode. The simulation results are in good agreement with the experimental data.

The mechanism of ignition of an HF discharge with a liquid jet electrode is substantiated. The discharge is ignited in the region of jet disintegration and its transition to the droplet phase because of increased current through the jet electrode, the appearance of an electric field with a strength of over 10^9 V/m, and field emission of primary electrons from the liquid electrodes.

As a result of experimental studies, it was established that the RF discharge with liquid electrodes can be effectively used for cleaning surfaces from contamination, removing dielectric coatings, and other material processing processes.

References

[1]. Son, E.E. et al. High Temperature (2014) **52**(4) 512–519.
[2]. Bruggeman, P.J., et al. (2016) Plasma Sources Science and Technology, **25**(5) 053002

*) abstracts of this report in Russian