Influence of the dielectric coating of the antenna on the parameters of the electrode microwave discharge

Lebedev Yu.A., Tatarinov A.V., Titov A.Yu. and Epstein I.L.

Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, Moscow, Russia, lebedev@ips.ac.ru

The results of 1-D and 2-D modeling showing the impact of such dielectric cover on the parameters of a non-equilibrium plasma of an electrode microwave discharge in hydrogen at reduced pressure (the change of the electrodynamics of the discharge, charge deposition on the dielectric surface, changing the catalytic properties of the surface of the antenna) are presented in this work. A two-dimensional model is applied for studying steady-state microwave field which is set inside the empty discharge chamber with the inner electrode covered with dielectric. The discharge chamber is described in detail in [1, 2]. Dielectrics with *ε* = 1, 2, 3, 4 and thicknesses d = 1, 2, 3 mm have been used for coating of the inner electrode. A one-dimensional model describes a microwave discharge in hydrogen, including the charge accumulation on the surface of the dielectric coating of the inner electrode. The model consists of the equation for the electromagnetic field in the quasi-static approximation, non-stationary balance equations for the concentrations of charged and neutral particles, and the Poisson equation for the field calculation of charge separation. All processes are described in [3, 4] in detail. The equation for the accumulation of the surface charge *σ*, deposited from the discharge, is solved at the dielectric-plasma boundary: , where **,**  are fluxes of ions of the *i*-th type and electrons to the surface of the insulator.

Modeling of the influence of the dielectric cover on plasma parameters of the microwave discharge in hydrogen at reduced pressure have shown that: (a) the use of dielectric covers of different thickness and different dielectric permeability makes it possible to control the spatial distribution of microwave field intensity near the antenna; (b) modification of electrodynamics and the deposition of charges on the dielectric surface only affect the surface layer of plasma and practically does not affect the characteristics of plasma in the plasma volume (e.g., the maximum value of the electron density); (c) catalytic properties of the dielectric surface strongly affect the maximum value of the concentration of hydrogen atoms in the case if their loss occurs due to the processes of diffusion and recombination on the surface; (d) deposition of charges on the dielectric surface leads to an increase in surface potential relative to the plasma, but the form of the spatial profile of the potential remains the same, and also leads to the shifting of the region of plasma resonance towards the surface of the electrode. It can be expected that when increasing the role of volume recombination of hydrogen atoms, the role of the recombination coefficient on the surface of the dielectric on the plasma parameters would be small.

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