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# KINETICS OF PROCESSES IN THE DISCHARGE OF METHANE IN WATER, TAKING INTO ACCOUNT THE GROWTH OF THE PLASMA BUBBLE *)

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Nonequilibrium discharges in various liquids have been the object of intensive research in recent decades [1, 2]. Microwave discharge is an effective means of conducting plasma chemical reactions in liquid media. This paper presents the results of modeling and experiments in a microwave discharge in methane, which flows into the water through the tube of the central electrode-antenna. The discharge is a sequence of bubbles growing at the end of the antenna electrode, which, having reached a certain size, break away from the electrode, float up and collapse on the surface of the water. After separation from the electrode, the discharge in the bubble stops, and the bubble with products, formed as a result of plasma-chemical processes, rises to the top. Chromatographic analysis of the composition of reaction products has been carried out.

During the simulation, the kinetics of processes is studied in the bubble, the volume of which is calculated at each time step. For each species, the equation of the balance of the number of particles is solved. The expansion of the plasma bubble occurs due to the following processes: the presence of a constant flow of methane through the supply tube; evaporation of the surrounding water into the plasma bubble; changes in the total number of particles due to plasma-chemical processes; changes in plasma temperature due to chemical reactions and ohmic heating. The thermal conductivity equation is used to calculate the gas temperature of the plasma. It is also assumed that all microwave power is spent exclusively on heating plasma electrons.

The simulation allows us to determine the characteristic growth time of the bubble until its complete separation from the electrode. The characteristic reduced field at the moment of bubble separation reaches values of 30-40 Td with a power absorbed by the plasma of 200 watts. The main plasma ions are $C_2H_2^+$ and $OH^-$. The main decomposition products are hydrogen and carbon monoxide. The agreement of the simulation and experiment results is satisfactory.

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## References

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[2]. Lebedev Yu.A., Plasma Phys. Rep. 2017, V. 43, P. 577-588

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