MODELING OF THE MICROWAVE DISCHARGE IN WATER [[1]](#footnote-1)\*)

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

TIPS RAS, Moscow, Russia, lebedev@ips.ac.ru

Discharges of various types in water have been the subject of intensive research in recent decades. The present work continues a series of works on modeling a microwave discharge in liquids and is devoted to the study of kinetic processes in a gas mixture of water decomposition products. The calculations were carried out for atmospheric and low pressure (30 torr) for several values ​​of the gas temperature in the zero-dimensional and one-dimensional approximations.

The model used contains the balance equations for neutral and charged gas components of the plasma, the Boltzmann equation for free plasma electrons, the equation for the average microwave field in a small volume filled with plasma [1] and the Poisson equation. Preliminary calculations were performed in the zero-dimensional approximation using the kinetic scheme proposed in [2, 3] for a constant microwave field. These calculations made it possible to analyze the role of various reactions in the processes of dissociation of water, the formation of neutral products, in particular hydrogen, and in the formation and loss of negatively and positively charged particles for different values ​​of *E*/*N* and gas temperature. Thus, the *E*/*N* values ​​were determined at which the transition from electronegative to electropositive plasma occurs for atmospheric pressure and pressure of 30 Torr. The analysis made it possible to reduce the kinetic scheme to 19 components and 56 reactions. This reduction of the kinetic scheme facilitates the calculation in the one-dimensional approximation and the calculation we are planning in the future in the two-dimensional approximation. The shortened model includes positively and negatively charged ions: H2O+, H3O+, H5O2+, H3O+(H2O), H3O+(H2O)2, H3O+(H2O)3, O2+, H-, O-, OH-, electrons and neutral molecules H2O, H2, O2, OН, Н, О, H2O2, HO2. The gas temperature was considered equal to 2000 K and 500 K and did not depend on the composition of the plasma.

Calculations based on the dependence of the microwave field on the plasma parameters show that the plasma is electronegative in a wide range of microwave values at the antenna electrode for both atmospheric and low pressure cases. The concentration of electrons is low in comparison with the concentration of positive ions H3O+, H5O2+, H3O+(H2O)3, and quasi-neutrality is maintained by the negative ion OH-. The *E* field is weakened inside the plasma and large *E*/*N* values ​​are not achieved. Dissociation of water is not more than 20-25%. The main decomposition products are hydrogen, oxygen and hydrogen peroxide.

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References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Lt/ru/EE-Tatarinov.docx) [↑](#footnote-ref-1)