DOI: 10.34854/ICPAF.51.2024.1.1.127

INFLUENCE OF BUBBLING ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF MICROWAVE DISCHARGE IN LIQUID HYDROCARBONS *)

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Recently, there has been growing interest in the production of hydrogen and hydrogen-containing gases. Hydrogen is expected to become a safe and affordable energy source for sustainable development in terms of air pollution, energy security and climate change. Much attention is paid to the problem of producing hydrogen using low-temperature plasma in gas environments containing hydrocarbons or alcohol vapors. A special place among plasma methods is occupied by microwave discharge in liquid hydrocarbons and alcohol solutions due to its non-stationary nature and the fact that plasma-chemical processes occur in a gas bubble located inside the liquid at the end of the microwave antenna.

The experimental setup used to generate and study microwave discharges in liquid hydrocarbons is described in detail in [1, 2]. The discharge was initiated at the end of the central conductor of the coaxial line (2 mm in diameter), made of a steel tube for bubbling additional gases. The ignition of the discharge was recorded using a nine-frame electro-optical camera K011, an Avaspec-3648x14-USB2 spectrometer and a photodiode, the signal from which was output to an AKIP-4126/3A-X oscilloscope. A water cooler was used to separate the products of plasma-chemical reactions from liquid vapor. At the outlet of the reactor, the rate of product formation was determined using a flow meter and the composition of the main gas products by chromatographic analysis. The criterion for changing chemical activity was the change in the yield of various components of the gas mixture at the outlet of the reactor. The use of gas additives provides additional information and allows us to better understand the physics of processes in a microwave discharge in a liquid. The main goal of the work was to determine the possibilities of controlling the chemical activity of hydrogen production by a microwave discharge in liquid hydrocarbons, using the example of the oil solvent Nefras S2 80/120, using various bubbling gases (Ar, He, CO_2).

For the first time, the dynamics of rotational and vibrational electronically excited temperatures of particles in plasma was obtained. The influence of additional gases on the yield of various components of gas products has been established. The maximum yield values of hydrogen as the main gas product were 791 mL/min and 811 mL/min, the maximum achieved energy efficiency was 135.6 Nl/kWh and 162.2 Nl/kWh in Nefras with Ar and He bubbling, respectively.

The results obtained on the physical and chemical properties of microwave discharge in liquid hydrocarbons can be useful in determining the prospects for using this type of discharge in various applied problems.

The work was carried out within the framework of the state assignment of the TIPS RAS.

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*) abstracts of this report in Russian