Some of results of the study of microwave discharge in liquid C7-C16 hydrocarbons

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Microwave discharges in liquid hydrocarbons is a new object of study of plasma physics. In this paper, the discharge was ignited at the end of the antenna placed in a heat-resistant glass filled with liquid C7-C16 hydrocarbons. Installation the discharge and emission spectra are presented in [1, 2], and the self-consistent 2D simulation results are given in [3, 4]. In such a system the solid carbon-containing nanosized particles are formed. This paper presents the results of energy dispersive analysis (EDA) of solid samples and the question of where the solid particles are formed is investigated.

Results of EDA analysis of hard samples showed that it consists of carbon 80–90%, oxygen 2–15% and copper (below 2%). Oxygen concentration decreases and concentrations of other elements increase with an increase of number of carbon atoms in an initial hydrocarbon molecule. The presence of oxygen in the samples can be explained by its adsorption from the air, because sample before the analysis was in an air atmosphere. Minor amount of copper in the samples is due to the fact that the quarter-wave antenna is used to excite the microwave discharge was made of copper and was a source of copper due to erosion of the antenna.

Based on the analysis results of photographing the discharge cell after a short discharge when there is no heating of the hydrocarbon, it was concluded that carbon particles are formed in a gas bubble with plasma at the end of the microwave antenna. The particles were then transferred into a liquid. Vortex flows are generated in the liquid hydrocarbon due to heating of the liquid, and the solids are distributed throughout the volume of liquid.

It has been shown [2] that after initiation of microwave discharge graphene-like solid particles are formed in liquid *n*-heptane, and in liquid hydrocarbon after centrifugation and isolation of dispersed phase insignificant amounts (<1%) of polycyclic aromatic hydrocarbons are detected which can be precursors of grapheme-like carbon nanoparticles (color of liquid changes from transparent in initial *n*-heptane to reddish). Meanwhile GS/MS analysis (Thermo DSQ II apparatus) of *n*-hexane composition before and after treatment with microwave plasma reveals no changes the composition of hydrocarbon and no additional impurities. Probably the observed IR bands of polycyclic aromatic hydrocarbons are due to the presence carbon-containing nanoparticles which cannot be detected with GS/MS. Rough measurements with a Zetatrac laser analyzer (*λ* = 750 nm) indicate possible presence of dispersed nanoparticles with size about 3 nm.

References

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