visualization of microwave discharge in liquid hydrocarbons

K.A. Averin and Yu.A. Lebedev

Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, Moscow, Russia, [lebedev@ips.ac.ru](mailto:lebedev@ips.ac.ru)

The nonequilibriuml plasma, located inside the gas bubbles in the liquids, is the subject of intense research in the last decade [1]. Using such systems, plasma is an effective means of plasma-chemical reactions. This work continues the studies in TIPS RAS [2–4]. Its purpose is the visualization of the discharge in liquid hydrocarbons with different viscosity.

Experimental set0up was described in detail in [2–4]. It is a metal chamber, which with the help of a rectangular waveguide was fed with microwave energy from the magnetron (2.45 GHz, 500 W). The container made of heat resistant glass with a quarter-wave length microwave antenna located on the metal base was placed in chamber. Hydrocarbon (volume about 50 ml) was poured into a container and completely covers the antenna. When applying microwave energy, the end of the antenna placed in the region of maximum microwave field was heated, hydrocarbon was evaporated and microwave discharge was initiated in the gas bubble.

N-heptane and hydrocarbons with viscosities in the range of 6.5–11 mm2/s were used. Visualization of the discharge was carried out by a video camera (250 frames per second). In addition, the treated hydrocarbon with carbon particles formed immediately after the experiment was photographed. This enabled to study the regions of the carbon particles generation when using viscous hydrocarbon.

Analysis of the photos shows that the carbon particles are formed in the gas bubble near the antenna and the process is initiated by microwave discharge. The particles were then transferred into a liquid. It is also found that the size of the gas bubble formed by microwave discharge in the n-heptane is of 2.5 mm, and the rate of its rise in the fluid is about 15 cm/s. This is consistent with the results obtained in the simulation of the discharge [5].

References

1. Bruggeman P., Leys C. J. Phys.D: Appl. Phys, 2009, V. 42, 053001.
2. Buravtsev N.N., Konstantinov V.S., Lebedev Yu.A., Mavlyudov T.B. Microwave Discharges: Fundamentals and Applications ed. By Yu.A. Lebedev. - Yanus-K, 2012, P. 167-170.
3. Lebedev Yu. A., Epstein I. L., Shakhatov V. A., Yusupova E. V., Konstantinov V. S. High Temperature, 2014, V. 52,p. 319.
4. Ю. А. Лебедев, В. С. Константинов, М. Ю. Яблоков, А. Н. Щеголихин, Н. М. Сурин. - Химия высоких энергий, 2014, т. 48, с. 496
5. А. В. Татаринов, Ю. А. Лебедев, И. Л. Эпштейн, А. Р.Мухамадиева. Химия высоких энергий. 2016, Т.50, № 1 (принята к печати)