Optical emission spectra and gas products of microwave discharge in liquid hydrocarbons [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.107

Lebedev Yu.A., Shakhatov V.A., Averin K.A.

A.V. Topchiev Institute of Petrochemical Synthesis RAS (TIPS RAS), Moscow, Russia, lebedev@ips.ac.ru

This work continues the cycle of studies of microwave discharges in liquid hydrocarbons. Previously, a discharge in liquid n-heptane was studied and solid products formed in the discharge were studied [1, 2], changes in liquid n-heptane after ignition of a microwave discharge in it [3] were studied, discharge spectra [4] and the effect of additives were studied argon [5], 2D, 1D, and 0D models, including those with the formation of a solid phase, are presented in [6–8].

This work presents the results of a study of the emission spectra of the discharge and gas-phase discharge products in a wide class of hydrocarbons (hexane, n-heptane, decane, pentadecane, cyclohexane, toluene, ortho-xylene, petroleum solvent Nefras S2 80/120). A discharge in the volume of liquid n-heptane was initiated at the end of the central conductor of the coaxial line (diameter 1.5 mm) [3-5]. The pressure above the surface of the liquid was equal to atmospheric pressure. Gas phase products were analyzed by the gas chromatography method. The emission spectra of the discharge were analyzed using an AvaSpec 2048 spectrograph, and the gas and vibrational temperatures were determined from the emission of the Swan bands [4].

It was shown that in the spectra measured in aromatic hydrocarbons (toluene and ortho-xylene), the sequence of the Swan band with Δυ = 0 overlapped with the molecular radiation band with a maximum at 511 nm. The analysis showed that this radiation can be attributed to the transition. The rotational temperatures determined by modeling the sequence with Δυ = - 1 Swan bands were equal to 2000–300 K for all studied hydrocarbons.

The study of the main gas products (Н2, С2Н2, С2Н4, СН4) showed that: (1) in the series of increasing molecular weight of alkane there is an increase in the yield of acetylene and a decrease in the yield of hydrogen; (2) in aromatic compounds, hydrogen and acetylene are predominantly formed; (3) the products of the studied cycloalkanes and aromatic compounds without radical groups practically do not contain methane or ethylene. As the number of radical groups increases, the composition approaches the composition of the discharge products in alkanes.

This work was fulfilled in the frame of State plan of Tips RAS with partial support of the RFBR grant (No. 18-08-00146).

References

1. Lebedev Yu.A., Konstantinov V.S., Yablokov M.Yu., Shchegolikhin A.N. and Surin N.M. High Energy Chem. 2014, V.48, P.385.
2. Averin K.A., Lebedev Yu.A., Shchegolikhin A. N., Yablokov M. Yu. Plasma Processes and Polymers, 2017, V.14, Issue 9, e201600227 .
3. Lebedev Yu.A., Averin K.A., Borisov R. S., Garifullin A. R., Bobkova E.S., Kurkin T.S. High Energy Chem., 2018, V.52, P.324.
4. Lebedev Yu.A., Shakhatov V.A. Eur Phys. J. D, 2019, V. 73, P.167.
5. Averin K.A., Bilera I.V., Lebedev Yu. A., Shakhatov V.A., Epstein I.L. Plasma Process Polym. 2019. V.16, e1800198.
6. Lebedev Yu. A., Tatarinov, A. V., Epstein, I. L. and Averin, K. A., Plasma Chemistry and Plasma Processing, 2016, V.36, P.535.
7. Lebedev Yu.A, Tatarinov, A. V., Epstein, I. L.J. Phys. D: Appl. Phys. 2018, 51, 214007.
8. Lebedev Yu.A., Tatarinov A.V., Epstein I.L. Plasma Chemistry and Plasma Processing, 2019, V. 39, P.787.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/EI-Lebedev.docx) [↑](#footnote-ref-1)