Abstract of doctoral dissertation

"Carbon structures formation in a constant-voltage electric discharge in needle-plate geometry in a flowing mixture of argon and cyclohexane"

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These thesis presents results of experimental studies of electric discharges in a flowing gas containing hydrocarbons in order to better understand the mechanisms of synthesis of carbon micro and nanostructures deposited on discharge electrodes. During the discharge in cyclohexane and argon mixture, tests were performed in the needle-plate electrode system supplied with DC high voltage. The carrier gas containing hydrocarbons flowed perpendicularly to the axis of the electrodes. It was found that the growth of carbon fiber occurred for a corona discharge of glow type, with positive polarization of the discharge electrode.

The dissertation comprises of 6 chapters.

The first chapter of the work, the purpose and scope of the thesis is presented and the dissertation thesis is formulated. The research problem of the thesis was to determine the conditions necessary for the formation of carbon structures in a DC high-voltage electric discharge in a mixture of hydrocarbon (cyclohexane) and working gas (argon).

The second chapter analyzes the current state of research on the formation of carbon structures, in particular in low-current high voltage electrical discharge plasma, and presents the most commonly used methods of plasma generation to obtain the desired carbon structures. Based on the literature, the basic physical properties of the obtained carbon structures were presented, depending on the technology used.

Chapter 3 describes the physical basis of electrical discharges in gases, especially low-current high voltage discharges. Chapter 4 presents a technical description of the research, as well as the research procedures, analytical methods used in the research, and research equipment used both in the experiments and in the study of the physical properties of the obtained carbon structures.

The next part of the dissertation (Chapter 5) contains the results of own experimental research.

Section 5.1 presents the results of the current-voltage characteristics studies, and the effect of such parameters as electric current of the discharge, the distance between the electrodes, and the concentration of cyclohexane at the inlet to the discharge chamber on the morphology of obtained carbon structures.

Section 5.2. comprises the study of the growth of carbon structures in the discharge in a mixture of argon and cyclohexane vapors, and the analysis of SEM images of deposits obtained on the electrodes in the electric discharge, depending on the discharge current, the percentage concentration of cyclohexane at the inlet to the discharge chamber and the distance between the electrodes. The results of the analyses indicate that, depending on the current intensity and the distance between the electrodes, the obtained structures had a smooth surface or were covered with carbon nanowalls.

Section 5.3 contains the results of chromatography investigations of gaseous products produced in electric discharge in a mixture of cyclohexane and argon and analyses the effect of discharge current, distance between electrodes and percentage concentration of cyclohexane at the inlet to the discharge chamber on the resulting gaseous products. It was discovered that the main products of cyclohexane decomposition were hydrogen, ethylene and methane.

Section 5.4 concerns the optical emission spectroscopy studies during the formation of carbon structures. It was determined influence the discharge current, the distance between the electrodes and the percentage concentration of cyclohexane at the inlet to the chamber on the temperature of the deposit tip and the excitation temperature. The products generated during the decomposition of cyclohexane in the electric discharge and their influence on the growth of carbon structures were qualitatively determined.

Chapter 5.5 contains the study of the particle size distribution of electric discharges generated in the plasma column in a mixture of cyclohexane and argon, measured at the outlet of the discharge chamber.

Section 5.6 concerns the measurements of the Raman spectra of the deposits obtained in the electric discharge in a mixture of cyclohexane and argon. The influence of the discharge current, the distance between the electrodes and the concentration of cyclohexane at the inlet to the discharge chamber on the structure of the deposit obtained was determined. In addition to the 1310 cm^{-1} (D) and 1600 cm^{-1} bands, a 2D band associated with the graphene layer formed on the deposit was detected.

Chapter 6 summarizes the research work and the results obtained. Conclusions regarding the dissertation thesis and directions of further research work were formulated.