FORMATION OF PAH, FULLERENCES, NANOPARTICLES AND SOOT AT COMBUSTION OF HYDROCARBONS IN ELECTRIC FIELD

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The knowledge of mechanisms of soot formation and structures of soot particles is of great importance. The nature of soot remains a subject of intensive researches both within the framework of physics and chemistry of various forms of solid carbon, and when explaining a number of fundamental phenomena taking place in condensed media with various scale of structural ordering.

One more prominent aspect in the study of soot formation is the influence of an electric field on the flame structure, on the yield and structural characteristics of the soot being formed. It is revealed, that even application of an electric field of small intensity essentially influences the kinetics of burning and it is shown, that the process of soot formation in hydrocarbon flames is determined by the fact that the soot particle in a flame acquire a positive charge.

In the present work the research of influence of an constant electric field of different polarity, in burning of benzene in oxygen medium in C/O = 1.0 atomic ratio with adding of 10% argon by volume at P = 40 Torr on soot formation process, yield and structure of soot particles, yield of PAH and fullerenes in U=0…20 kV range were investigated.

The research of direct electric field influence on the soot formation process and soot particles structure were carried out at electrode system needle-space (L=18cm, $V_{x.cm.}$=18,4 cm/s, T_{max}=1200K). The burner was a space electrode. In result of lengthwise electric field imposition negative (“minus” on needle electrode) and positive (“plus” on needle electrode) crown charge was created. At U≥10kW crown charge transferred into smoldering, accompanying with appearance of lighting twisting slim cord (d_m=3÷5mm), connecting upper electrode with down one.

Obtained soot was studied on electronic microscope, on diffractometer DRON – 3M (Cu_α-radiation), IK – spectrometer and via cold extraction in C_6H_6.

The results showed that yield of soot can be increased by applying voltage (till 10%), comparing with the yield without applying voltage. Length of diameter of soot packet L_a was revealed to increase greatly in comparison with its height L_c when the voltage was changed and L_c had a tendency to decrease at positive polarity with the increase of voltage. Electric field increased the growth of average size of particles comparing with particles obtained without applying voltage. However, further increasing of voltage decreases the average size of soot particles at positive polarity and increases at negative polarity.

By using IR–spectroscopy C_{60}, C_{70} and PAH (pyren, fluoranten, coronene, antantren, 1,12-benzperylene) were determined in soot extracts. The wavelengths corresponding to fullerenes C_{60} and C_{70} were shown to be identified more accurately at a negative polarity that at a positive polarity. This confirms the fact that negative polarity exerts greater influence on the yield of soot than the positive one.

It was investigated, that at negative polarity with increasing of voltage, yield of PAH decreases, but at positive polarity a sudden decrease of yield occurred and then at U≥7 kV, yield of PAH increases.