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CARBON 2019

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METHOD OF GRAPHENE SYNTHESIS IN THE COMBINED FLAME

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Introduction

Since the discovery of the first method of obtaining graphene by mechanical splitting of graphite layers, the efforts of many researcher have been aimed at developing more effective approaches to solving actual problem related to the development of a reproducible method for the synthesis of graphene in macroscopic amounts. The flame is an ideal reactor for the production of carbon nanomaterials by the method of assembling them using a bottom-up mechanism, since in the flame, the formation of the final product occurs through successive elementary acts consisting of innumerable of chemical reactions that occur in a very short period of time. At present, the only problem remains the solution of the problem of controlling the reaction route of chemical reactions for the formation of desired combustion products. In the proposed study, a method for the selective use of intermediate combustion products as a building material for the formation of graphene has been developed to solve this problem. The main novelty of this research is to the use of the phenomenon combining of the reaction zones of flames during the combined combustion of different fuels. This allows you to influence the structure and property of the resulting final products of combustion, by changing the composition of intermediate particles in the reaction zone of the combined flame acting as building materials. The main advantages of the proposed method are the synthesis of graphenes in an open atmosphere, the short time of the graphene formation process and the absence of additional energy costs.

Materials and Methods

In order to create the combustion method that providing the combination of combustion zones of gaseous fuels an experimental setup was designed and created. The major unit of setup for combustion of gaseous fuels is a burner with coaxial arrangement of nozzles. The construction of setup allows to apply the separate fuel to each nozzle individually. The burner provides the possibility of displacement the nozzles that relative to each other on vertical axis, and this fact regulate the concentration density and composition of intermediate particles in combined zone of flames.Obtained samples were examined with the help of transmission (JEM 1011), scanning (Quanta 3D200i) electron microscope, Raman spectroscopy (NTEGRA Spectra Raman, λ = 473 nm, the area signal with a diameter of 80 nm).

Results and Discussion

Research on the formation of graphene layers were carried out in alternation flame of propane with ethanol (propane is fed to the middle) and ethanol with propane (ethanol is fed to the middle). It was found that at the substrate there is formed 5-10 layers of graphene (I_G/I_{2D} = 1,64-2,05), Raman spectra and Raman map of which are shown in Figure 1.

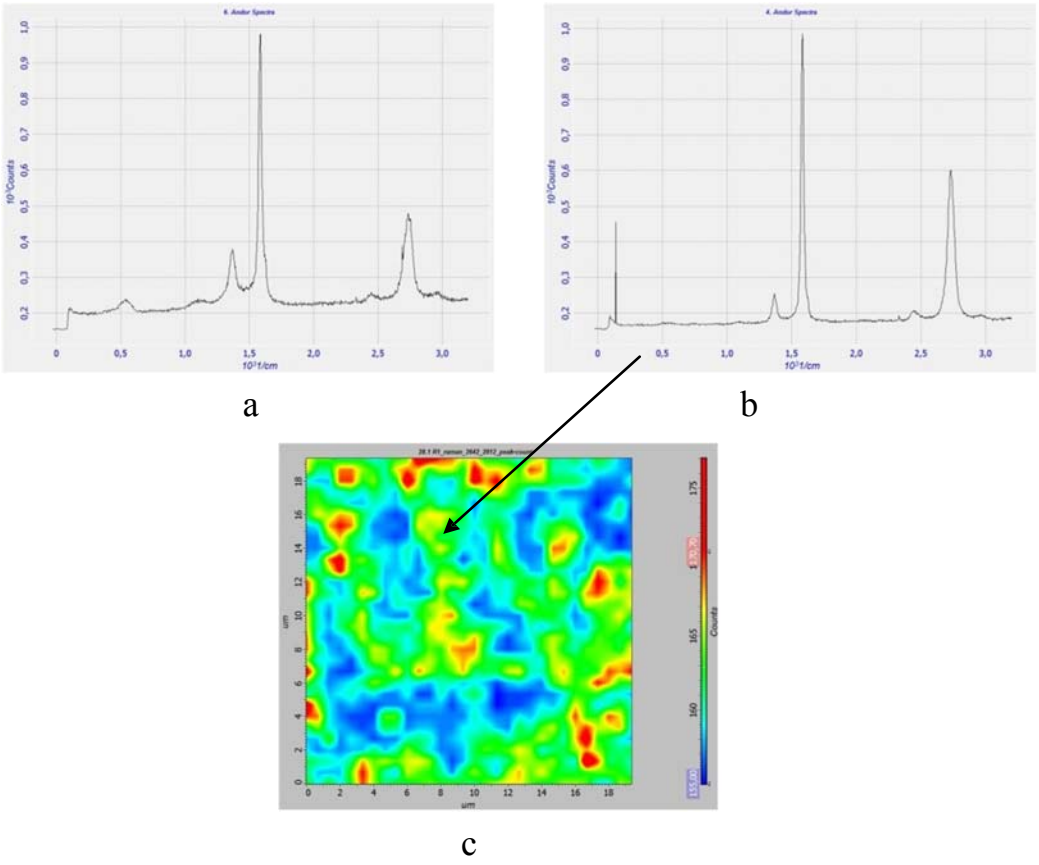

Figure 1 – Raman spectra (a,b) and Raman map (c).

Conclusions

Studies have shown the possibility of producing the graphene layers in alternation flame of propane with ethanol at atmospheric pressure at nickel substrate with small defectiveness in the range of I_D/I_G = 0,26 – 0,39. It was found that at fed of ethanol to the center of flame there is formed 5 graphene layers with defective I_D/I_G = 0,26.

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