

IMPROVEMENT OF APPARATUS FOR MANUFACTURE NANOMATERIALS BY COMBUSTION METHOD

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Introduction

Carbon nanostructure materials attractive an attention of scientists to investigation of its properties and application at many branches of industry. This elucidates the systematic investigation the processes of nanomaterials synthesis for its development and embodiment to manufacturing for providing of industry and scientific institutes.

Various methods, such as arc discharge, laser ablation, solar method, pyrolysis, thermal chemical vapor deposition have been successfully used to synthesis fullerenes and carbon nanotubes (CNTs).

Diffusion flame synthesis of fullerenes and CNTs is a newly developed method which uses nitrogen diluted acetylene, ethylene, methane or ethanol [1,2] as a fuel. Compared to the above methods, flame synthesis offers several inherent advantages: flame can quite naturally provide the elevated temperature for fullerenes and CNTs synthesis at atmospheric pressure; flame synthesis is proved to be an economical method for large areas by either extended flames or with multiple flames; allows a controllable residence time within a desired flame regions, etc.

However, the diffusion flame synthesis method uses a very complicated burner and other apparatuses.

Results and Discussion

The known devices for the nanostructures production contain combustion chamber, feed pipes of fuel and oxygen, burner and soot collector [3,4].

Hydrocarbons including products derived from oil, coal and biomass are used as fuel, and oxygen is as oxidizer.

The condensates can be continuously utilized by means of the devices, for example, electrostatic separator or cyclon. However it is impossible to influence on both the quality and the quantity of nanotubes obtained.

Character an obtaining of the fullerene nanostructure materials such as the nanotubes onto the soot collector surface depends considerably on a phenomenon of the material surface. Increase the capacity of nanotubes in combustion products is reached at the expense of

both the improvement conditions of nanotube synthesis on regularity renovated surface of moving ribbon and the catalytic influence of the ribbon material.

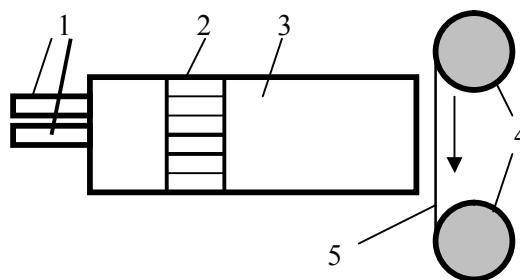


Figure 1.

1 – feed pipes of fuel and oxygen;
2 – burner; 3 – combustion chamber;
4 – drive mechanism; 5 – ribbon.

The schematic of the experimental apparatus [5] is shown in Fig.1. Through the feed pipes the fuel and oxygen are fed to the burner, and the mixture are burned there. In the flame the carbon clusters – nanostructure components of fullerenes and nanotubes are formed. Then all together with hot gas leave the combustion chamber and are deposited onto the ribbon surface which is pulled in perpendicular to the combustion chamber flat. A velocity of the ribbon pulling needed for making of the nanotubes synthesis process in optimum rate is determined by means of experiments. The velocity is depended essentially from catalytic properties of the ribbon material. Nickel, cobalt, iron, copper, molybdenum and its alloys as well metallic-amorphous materials on the base of them are used as the ribbon material. Choosing both the necessary materials and the configuration of the ribbon or the catalytic covering on its surface [6], it is possible to manufacture the necessary parts of electronic schemes and apparatus as well as the preforms of them.

A version of the apparatus with the soot collector of continuous action is shown in Fig 2 [7].

As design this is expressed in making the soot collector in the form of a disk which is revolved around the axle placed behind the combustion chamber in parallel to one.

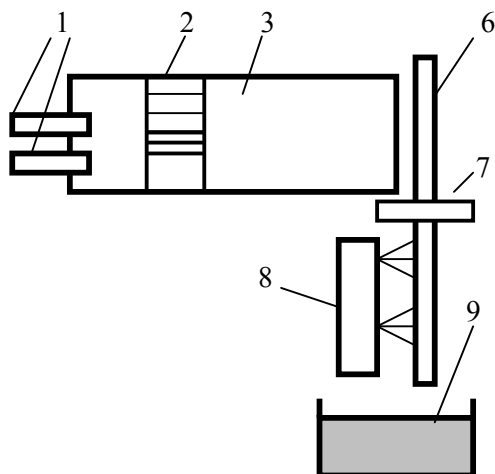


Figure 2.

6 – soot collector; 7 – rotation axle;
8 – brush; 9 – tank.

Nanostructure materials deposit and condense onto the disk surface turned to the combustion chamber. When the disk is revolving its zones with condensates are removed to the brushes which clean the disk surface from the burning products.

Thus it guarantees a continuity of the process of utilisation when the conditions of the nanotubes formation are improved.

Because the disk blocks up the combustion chamber outlet completely or in considerable part, the disk body is perforated for free passage the gas flow.

For modifying conditions of forming of the nanomaterials structure the soot collector is made of ceramics while its surface is covered with plates of metals, ceramics or quartz; the soot collector surface is sputtered with metal or ceramics. For simultaneous realisation of various conditions for obtaining of the covering surface, both the coverings and the sputtering are made by sectors where each sector has different from neighbours material of the surface.

In order to increase the nanotubes quantity in the products of the hydrocarbons burning, the apparatus' burner is provided by additional tap in conjunction with the mixer for feeding the mix of the gas and powder to the combustion chamber [8].

During burning the hydrocarbons a presence of a catalyst in the form of a fine powder which is in a flow of flying carbon clusters facilitates to the nanotubes obtaining and its growth. The fine powders of nickel, iron, copper, molybdenum, platinum, rhodium, palladium, its mixes as well alloys are applied as the catalysts.

Conclusion

Combustion method for producing of nanostructure materials is developing and has well prospective in plane of improvement of technological possibilities and for increasing of industry powers also. Side by side with simplicity and economical advantages, the possibilities of influence on both the form and the quality of the nanomaterials resulted are very attractive.

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