SYNTHESIS OF CARBON NANOTUBES IN Plasma jet REACTOR IN PRESENCE OF CATALYSTS

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For the purpose of development of high-performance technology of production of carbon nanotubes (CNT) their synthesis in plasma jet reactor on the basis of a direct current plasma torch with the design features providing good opportunities for development of investigations at direct evaporation of materials on the basis of carbon and their subsequent condensation [1] has been investigated. Experiments were carried out at the electric power of a plasma torch up to 25 kW. As plasma gas helium and argon were applied. Helium was used with pressure of 350-710 Torr at gas flow rate from 0,5 to 1 g/sec, the gas flow rate of argon was from 1,5 to 3 g/sec with pressure of 450 - 600 Torr. CNT synthesis at pyrolysis of soot was carried out in the presence of catalysts. The metal disperse powders of Ni, Co, Y2O3 were used. The consumption of soot with catalysts was 0,3-1,3 g/min. The methods of x-ray diffraction and of electronic microscopy were applied to investigate the structure of received products. The **thermo-gravimetric analysis** was used to determine the phase structure of carbon nanomaterials. For the analysis the products of condensation of the carbon were taken from different part of the metal target [1] when the concentration of catalysts, pressure and gas flow of gas were changed.

With a pressure of helium of 600 Torr and the weight content in soot of catalysts of 10% (Ni +Co) the formation of the quasiamorphous structure corresponding to a condition of plastically deformed material on which surface Ni and Co particles settled down was observed. Y2O3 additive in soot in the following weigt proportions Ni: Co: Y = 5,4%: 5,4%: 7,2% and decrease of pressure of plasma-forming gas to 500 Torr initiated the formation of CNT with a diameter of 60 nanometers. At 600 Torr of Ar the product of synthesis contained CNT in a look "a sea hedgehog". Decrease of a consumption of soot with catalysts with weight proportions Ni: Co: Y = 4,5%: 4,5%: 6,0% to 0.32 g/min and with pressure of He 500 Torr increased CNT production. The dispersion of diameter of CNT was thus observed. CNT were defective on structure and distributed on a quasiamorphous surface of a matrix of soot, instead of is perpendicular to it. Difference of morphology of received products on the center of the target and on the periphery was established. On the periphery polyhedral particles acted as nanostructures. As a whole when using helium formation of CNT is effective than at argon application. When using argon a large amount of amorphous carbon and spheroidal nanoparticles is formed. Diameter of synthesizable carbon nanotubes changed from 16 to 74 nanometers depending on conditions. Morphological researches coordinated with termogravimetriya data.

As a whole the experimental data allowing step by step to scale process of production of СNT of desirable morphology have been obtained. The dependence of the structural and of the morphological properties of СNT received at evaporation of soot in the presence of high-percentage combined catalysts has been established with catalyst structure.

References

1. R.H.Amirov, E.I.Asinovsky, E.Kh.Isakaev and V.I.Kiselev // Journal of High Temperature Material Process. 2006. V.10. No2. P.197.