CATALYSTS EFFECTS ON THE PRODUCTION OF CARBON NANOTUBES BY AN AUTOMATIC ARC DISCHARGE SET UP

Mohsen Jahanshahi [1,], Jahan B. Raoof [2], Solmaz Hajizadeh [1], Razieh Jabari Seresht [1]*

[1] Nanobiotechnology Research Laboratory, Faculty of Chemical Engineering, Babol Noshirvani University of Technology, PO. Box 484. , Babol, Iran. . mjahan@nit.ac.ir, mmohse@yahoo.com

[2] Electroanalytical Chemistry Research Laboratory, Department of Chemistry, Faculty of Basic Science, Mazandaran University, Babolsar, Iran

Abstract

Carbon nanotubes (CNTs) represent an important group of nanomaterials with attractive geometrical, electrical and chemical properties. CNTs can be synthesized using a variety of techniques. In this study CNTs were fabricated by electric arc discharge method in liquid which does not require vacuum equipment, heat exchange system, active or inert gases. The effect of the kind of catalyst on quantity of synthesized CNTs was studied in this paper. Carbon nanotubes were fabricated between two graphite electrodes which are submerged in the LiCl 0.25N as a plasma and with a voltage of 25v while for comparative studies, Ni, Mo, Fe, Ni-Mo were used in synthesis as metallic or bimetallic catalysts and the results then were analyzed, compared and discussed. The arc discharge set up which used in this study was full automatic that enables the controlling of gap between the two electrodes. Then for purification purpose a modified acid treatment method were applied. To analyze the morphology of the synthesized products a scanning electron microscopy (SEM) and transmission electron microscopy (TEM) study were employed. A Raman spectroscopy was utilized for investigation on amount of purity. A High-crystalline and alonged multi walled carbon nanotubes (MWCNTs), single walled carbon nanotubes (SWCNTs) and springy carbon nanotubes (SCNTs) can be synthesized using this technique with carbon electrode including 5% Mo-Ni as catalysts.

References

[1] S. Iijima; “Helical Microtubules of Graphitic Carbon”, Nature 354 , 56-58 (1991)

[2] S. Iijima, T. Ichihashi; “Single Carbon Nanotube of 1-nm Diameter”, Nature 363, 603-605 (1993).
[3] W. Thomas, “Carbon Nanotubes” University of Washington (2007).
[4] X. Zhao, M. Ohkohchi, H. Shimoyama, Y. Ando “Morphology of carbon allotropes prepared by hydrogen arcdischarge” Crystal Growth 198/199 ,934-938(1999).
[5] C. D. Scott, S. Arepalli, P. Nikolaev, R.E. Smalley “Growth mechanisms for single-wall carbon nanotubesin a laser-ablation process”, Appl. Phys. A 72, 573–580 (2001).
[6] Flahaut, et.al, “Gram-Scale CVD Synthesis of Double–Walled Carbon Nanotube” , Chemical Communications , 1442-1443(2003).
[7] M. Daenen, R. D. de Fouw, B. Hamers, P. G. A. Janssen, K. Schouteden, M.A.J. Veld; “The Wondrous World of Carbon Nanotubes”, Eindhoven University of Technology (2003).
[8] H. Molavi, M. Shariaty-Niassar, M. Jahanshahi; “Comparative Study of CNT Synthesis by Arc Discharge in Solution”, Proceedings of the International Conference on Bio-Nanotechnology: Future Prospects in the Emirates November 18-21, Al Ain, United Arab Emirates (2006).
[9] R. B. Mathur, S. Seth, Ch. Lal, R. Rao, B. P. Singh, T. L. Dhami, A. M. Rao; “Co-synthesis, purification and characterization of single- and multi-walled carbon nanotubes using the electric arc method,” carbon, 45, 132-140 (2007).
[10] H. Lange, M. Sioda, A. Huczko, Y. Q. Zhu, H. W. Kroto, D. R. M. Walton; "Nanocarbon production by arc discharge in water", Carbon 2003;41:1617–23.
[11] R. David Lide; "CRC Handbook of Chemistry and Physics", 85th ed., p.938, New York, U.A.S. (2005).