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**Helium ion microscopy for carbon nanotubes characterization**

Helium Ion Microscopy (HIM) has many advantages compared with other microscopic techniques. Focused beam of positively charged helium ion is used in HIM, so HIM imaging results in only positive charging, that can be compensated with an electron flood gun. Also it is characterized by its spatial resolution which reaches to 0.3 nm and the high depth-of-field. In this work HIM was used to image the surface of carbon nanotubes (CNTs) synthesized from different types of alcohols by chemical vapour deposition (CVD) technique with and without catalysts. HIM imaging was used to evaluate the quality of the produced CNTs. In this work we tried to avoid using catalyst due to the complicated procedure that should be used for the purification of CNTs to remove the catalysts. Moreover, synthesizing of CNTs without catalyst gives more safe pharmaceutical applications. CNTs were obtained from this technique by following these conditions which include: using alcohols as carbon source in three forms (ethanol, 1-propanol and 2-propanol), type of catalyst and support were mixture of two materials Fe/MgO at fixed ratio 1-10. The synthesis time was 1:30 hr, growth temperature was 750 oC and the type of carrier gas was nitrogen gas with

flow rate 100 ml/min. The four HIM images showed that CNTs synthesized from ethanol without catalyst is a promising technique especially for pharmaceutical applications. The HIM image of synthesized carbon nanotubes at 750 oC from ethanol without catalyst refers to existence of MWCNTs with the very little amount of other element due to the deposition process performed without using of catalyst as indicated in the Energy Dispersive X-ray (EDX) analysis. Also the average length of grown carbon nanotubes was ranged from 300 nm to 1  $\mu$  and the average diameter is ranged between 30-50 nm and also the pour mouth of nanotube was observed. HIM image of grown carbon nanotubes at same temperature with the existence of catalyst produced multiwall carbon nanotubes (MWCNTs) and few wall carbon nanotubes (FWCNTs) with the some elements which related to the residue of the catalyst as indicated in the EDX analysis. The dimensions of this sample were the average length of carbon nanotubes which was 100-400 nm and the average diameter was 20-30 nm respectively. These nanotubes with low diameters and number of layers are due to the use of catalyst particles (Fe/MgO) as support.

**Biography**

Falah H. Hussein is the Professor in University of Babylon. He completed his PhD in Physical Chemistry from Nottingham University, England and MSc in Physical Chemistry from University of Salahaddin, Iraq. He has served several positions as Head Assistant of Chemistry Department- College of Science- Sulaimaniyah University, 1979-1980; President of Al-Qadisya University, 1994 and many more. He has more than 50 publications. He is also prestigious members of Head of Scientific Consultant Bureau Committee, International Solar Energy Society.

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