Abstract No: 79 ***Physical Sciences***

SINGLE-STAGE VERTICALLY ALIGNED CARBON NANOTUBES (VACNTS) SYNTHESIS BY PYROLYSIS OF FERROCENE AND ACETYLENE

G.D.G.D.P. Wijerathne, B.V.N. Sewwandi, and A.R. Kumarasinghe*

Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**argk@sjp.ac.lk*

Carbon nanotubes (CNTs) have drawn much interest in material science due to their unique structure and extraordinary properties. Among different morphologies of CNTs, vertically aligned carbon nanotubes (VACNTs) are a fascinating class of nanomaterials that are highly dense and well-oriented along their longitudinal axis. For the fabrication of CNT macrostructures with morphologies ranging from network to aligned structures, the floating catalyst chemical vapour deposition (FC-CVD) technique is more successful and favourable than the conventional CVD methods. This study represents an effective method for synthesizing VACNTs using a novel single-stage FC-CVD process with high CNT yield, low cost, and facile fabrication. FC-CVD process was carried out by pyrolysis of ferrocene and acetylene at the temperature of 850 ^{0}C under a stream of Nitrogen (flow rate of 200 sccm) and Hydrogen (flow rate of 50 sccm). This single-stage FC-CVD approach has a substantial potential to produce VACNTs on a large scale compared to the traditional multi-stage assisted FC-CVD process. The as-grown CNTs were collected separately from the Si/SiO_2 wafer, silicon wafer, and the inner walls of the quartz furnace. The morphology and structure of the as-grown CNTs were investigated by SEM, Raman, and XRD. The formation of dense VACNT arrays was observed on the inner walls of the quartz furnace and silicon wafer under optimized conditions where 0.4 g of ferrocene and an acetylene flow rate of 100 sccm were used for a growth period of 30 minutes. CNT bundles with an average diameter of 70 nm and 90 nm with vertical heights of 170 µm and 9 µm were found on the quartz and silicon wafer surfaces, respectively. Steric effects and Van der Waals repulsive interactions led to the arrangement of dense vertical alignment. More randomly-oriented CNTs with varying diameter distribution were also observed on the Si/SiO_2 substrate. It revealed the dependency of the surface properties on the formation of CNTs with a distinct morphology. XRD and Raman studies showed that as-grown VACNTs are well-graphitized and indicated that the graphite structure resembles MWCNTs.

Financial assistance from the National Research Council (Grant No 16-015) is acknowledged.

Keywords: Acetylene, Ferrocene, Pyrolysis, Single-stage floating catalyst chemical vapour deposition (FC-CVD), Vertically aligned carbon nanotubes (VACNTs)