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Carbon Nano Tubes Actuating Implantable Medical Devices

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Abstract: The Most fascinating property of Carbon Nano Tubes (CNT) is the creation of potential drifton interaction with Fluid in flow Dynamics. The Columbic interaction between the ions in the fluid and charge carriers in nanotube plays a key role in impulse generation.CNT on interaction with Biological fluids engenders a Potential which can be amplified and Transmitted through the Nanowires that would serve for driving the Implantable Medical Devices. Biocompatibility, environmental impacts and other Biological elements of CNT in the Human Body are studied by in vitro and in vivo research; this new technology can be deliberated as one of the most fascinating invention. Consequently this approach overlooks the Patient Hiking to the Operation Theatre (OT) Intermittently.
Keywords*:* CNT, Fluid Dynamics, Angular Velocity, Potential Drift, Biocompatibility.

1. Introduction

Carbon nanotubes (CNTs) areunusual in propertymaking possibleapplicationsranging from battery electrodes, to electronic devices, to reinforcing fibers, which make stronger composites [1].Single-walled carbon nanotubes (SWNTs)are a key aspect in the emerging field ofnanotechnology. Current synthesismethods suffer from the production ofimpurities that must be removed throughpurifications steps, which can damage thenanotubes. Dispersion of SWNTs in solutions for further processing also presentschallenges because the smooth-sided tubesreadily aggregate and form parallel bundlesor ropes as a result of van der Waals interactions [2].

2. Synthesis of Carbon Nano Tubes

Chemical Vapor Deposition Technique:

H_2O were used for endorsing catalytic activity coated with ferric nitrate to produce Single Walled CNT. The main precursor gas is acetylene along with Ar, He, H_2. CNT were grown on Si substrates in a tube-shaped furnace. Synthesis Environment embraces synthesis procedure from [3] is adopted. The Si substrate with the catalyst is placed in a ceramic boat at the center of the CVD Hot chamber with initial temperature of 500 $^{\circ}$C. Ar

(200 ml/min),H_2 (50 ml/min),acetylene (15ml/min) and Ar (55ml/min) is passed for 30 min,35 min and15 min passed at 800 $^{\circ}$C respectively. At last Argon(66.6ml/min) is passed to cool for 1 hour. The crude CNT sample produced consists of catalytic and amorphous carbon impurities, which can be removed using various purification methods. A wet purification method comprising ; mixing the crude CNT in nitric acid, followed by agitation using ultrasonic waves and filtering to remove the metallic impurities. The second step involves immersing the crude CNT from the first step in hydrogen peroxide solution followed by ultrasonic agitation, and then filtering to remove amorphous carbon. The purified carbon nanotubes are then dried in a desiccator for a day.

3. Apparatus design for Potential tapping

The apparatus is specially designed in such a way that the contact of the flow of bio fluidic environment comes in close contact with that of coated structures of the single walled CNT. The schematic of the apparatus was completely simulated with 3 D structure for better efficiency to completely make the coated sample to respond to the experiment.

4. Bio Fluidic Flow dynamics

The consecutive Ionic interaction on the surface of the CNT occurs. The Fig.1 clearly visualizes us the interaction of bio fluidic elements along the structure of the SWNT. The Bio Fluid Ions that could interact with the CNT are namely Na^+,K^+,Ca^{2+},Mg^{2+}. Majorly Lymph of 6 to 10 Liters and Blood of 3.5 to 5.5 Liters full fills the idea of flowing on the surface of SWNT reporting the velocity gradient (shear) at the Liquid-Solid Interface. Both the Intracellular and Extracellular Fluids serve with this property. The Flow induced current is relatively weak independent on the Liquid Viscosity.

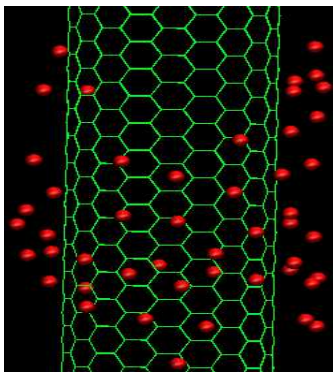

Fig. 1. Bio Fludic Ions Movement over the surface of the CNT

5. Characterization Techniques

Fig.2 shows the Scanning Electron Microscope result of CNT obtained with an approximate length of 3-5µm take at the lens scale of 2µm with the magnification of 6.98 K X; the surface of Carbon Nano Tubes are surfed in bundles. Methyl Thiazole Tetrazolium (MTT) Assay using lymphocytic cells in 100 µg of sample resulted 81.21 % viability.

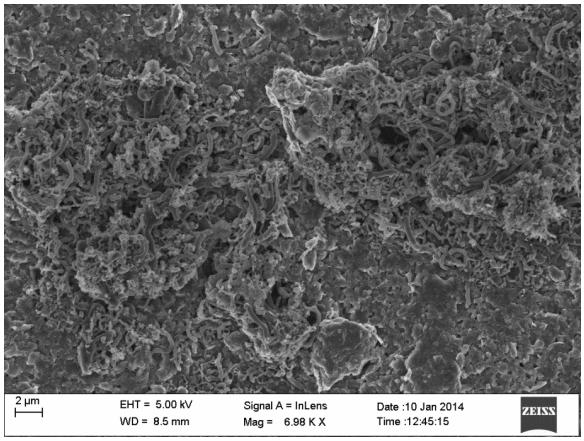

Fig. 2. Scanning Electron Microscope report for CNT on the surface

6. Conclusions

CNT have been a plethora of applications proposed in the biomedical field alone. However, such materials can be successfully incorporated into biomedical implants. Early biocompatibility data for CNT and novel Nano-structured biomaterials suggest that the scientific community could remain cautiously enthused by potential biomedical applications of CNT-based materials. Finally, Impulse Power Source for Implantable Medical Device which is based on SWNT Property directly produces an electrical signal in response to a fluid flow. We believe that this approach can be scaled down to length dimension in the order of micrometers—i.e., the length of the individual nanotubes making it usable in very small Bio fluidic volumes. The nanotubes also could be used to make a Sensor /Lab on Chip in a flowing liquid environment, which will have interesting biomedical applications.

References

1. C.P. Poole Jr., F.J. Owen, Introduction to Nanotechnology, John Wiley Inter-Science Publication, Canada, 2003.
2. Kenji Hata, Don N. Futaba,Kohei Mizuno, Tatsunori Namai,Motoo Yumura, Sumio Iijima “Water-Assisted Highly Efficient Synthesis of Impurity-Free Single-Walled Carbon Nanotubes”, SCIENCE (www.sciencemag.org) VOL 306, 19 NOVEMBER 2004,pp 1362-1364.
3. J. Fredrick Johnson, M. Karthick, Sathiesh Kumar S., G. Gopu”Carbon Nanotubes as a Cradle of Impulse for Implantable Medical Devices. The 15th International Conference on Biomedical Engineering IFMBE Proceedings Volume 43, 2014, pp 456-459.
4. Shankar Ghosh A. K. Sood, N. Kumar “Carbon Nanotube Flow Sensors”, Science 2003 Feb 16;299 (5609), Epub 2003 Jan 16, pp 1042-4.

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