MILESTONE@UM
NEWSLETTER
Volume 2(1)/2014

Mass Production of Carbon Nanotubes using Microwave Technology

Carbon nanotubes (CNTs) are among the most eminent materials in the evolution of nanotechnology. The most eye-catching features of these structures are their electronic, mechanical, optical and chemical characteristics, which open a way to future applications.CNTs are extremely strong with the strength of tens of gigapascals (GPa) and exceptionally stiff with Young's modulus in terapascals (TPa) range. CNTs are probably the strongest substancewith a tensile strength greater than steel, but only one sixth the weight of steel. Various methods to grow CNTs have been developed, including laser ablation, arc discharge and chemical vapor deposition (CVD). These methods produce CNTs with different characteristics, sometimes involving complex experimental set-ups that add to the cost of production. It is of current interest to develop new techniques for the efficient and selective synthesis of CNTs at the cheapest possible cost. One such possibility is the use of microwave radiation, which over the past few years, has played an important role as a thermal tool in organic synthesis due to its considerable advantages over conventional methods.

Researchers from the University of Malaya have developed a single stage mass production of CNTs using the Microwave Technology for various industrial applications. Our innovative microwave-assisted synthesis, including fast CNTs growth and ambient reaction condition, lowers the cost, and simplifies the procedure leading to a high yield synthesis of high-quality CNTs with minimal impurity. Unlike conventional heating, microwave heating has a higher heating rate which results from the intrinsic transition of electromagnetic energy to thermal energy by a molecular interaction with the electromagnetic field, rather than heat transfer by conduction or convection. In this study, mass production of CNTs are successfully synthesized using tubular microwave chemical vapour deposition (TM-CVD) technique, using acetylene (C2H2) and hydrogen (H2) as the precursor gases, and ferrocene as catalyst. Mass production of CNTs depends on various process parameters such as reaction power, radiation time, and gas ratio of C2H2/H2. Fig 1 shows the schematic of TM-CVD for CNTs production. The produced CNTshave high quality and high yield of uniformly dispersed CNTs with diameter of 10-25 nm as shown in Fig 2 and Fig 3.

Dr. Jayakumar Natesan (right) with his awards at MTE 2014

Awards

The Best Award

Gold
Malaysian Technology Expo
(MTE 2014)

Contact

Dr. Jayakumar Natesan Subramanian Nayagar
Dept. of Chemical Engineering
Faculty of Engineering
University of Malaya
50603 Kuala Lumpur

Tel : 03-79675294
Fax : 03- 79675319
Email : jaya_kumar@um.edu.my/
mubarak.yaseen@gmail.com

Patent Filed
PI 2013701556

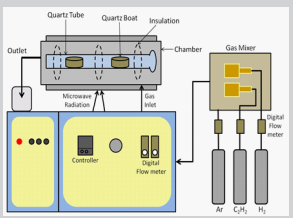


Fig 1. Schematic of TM-CVD for CNTs production


Produced CNTs

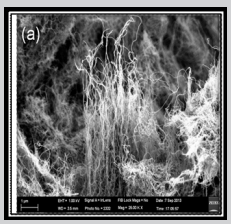


Fig 2 . FESEM image and of CNTs at optimum condition

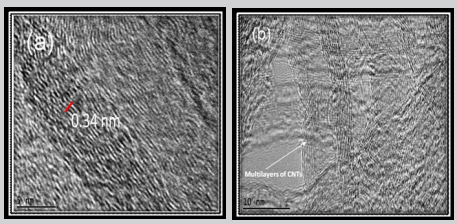


Fig 3 . HRTEM image and of CNTs at optimum condition

MILESTONE@UM
NEWSLETTER Volume 1/2014

Eco-Greenergy™ Outdoor Lighting System

(powered by shrouded vertical-axis-wind-turbine and solar PV panel)

An innovative outdoor lighting system powered by a shroud-augmented wind turbine and solar panel is disclosed. It combines a hybrid renewable energy generation system, energy-saving lighting and rain water collector. This hybrid green energy system is a compact design that harmoniously integrates a vertical-axis-wind-turbine (VAWT) withthe omni-direction-guide-vane (ODGV), solar panel and LED lighting system. The ODGV is designed to surround the VAWTfor wind power augmentation. It is mounted on the post and used to guide and create the venturi effect to increase the wind speed before the wind-stream interacts with the wind turbine blades. This system fully utilizes the advantages of the Malaysian climate, i.e. high solar radiation and high rainfall for green energy generation and free water supply. It overcomes the low wind speed challenge in the tropics by guiding and increasing the speed of the wind from all directions radially through the guide-vanes before entering the VAWT at center portion. The solar panels can be mounted on the top surface of the ODGV for solar energy generation. In addition, the solar panel integrated platform can serve as a rainfall catchment area. The green energy generated from this wind-solar hybrid system is utilized to power the outdoor lighting system. LED light is preferred since it is an energy-saving light and lasts very long. Extra power generated (after fulfilling the lighting requirement) can be stored in a battery or used to supply energy demand of other appliances or fed into the grid line. Another important feature of this ODGV is that its bottom surface is painted with reflective color to act a reflector for lighting system enhancement. It is also safer to the public since the rotating parts of the VAWT are enclosed within the ODGV, and cause less disturbances to motorists for street lighting application.

Dr. Chong Wen Tong (right) with his award at MTE 2014

Awards

Gold
Malaysian Technology Expo (MTE 2014)

Gold
Malaysian Technology Expo (MTE 2013)

Gold
International Invention, Innovation and Technology Exhibition (ITEX 2013)

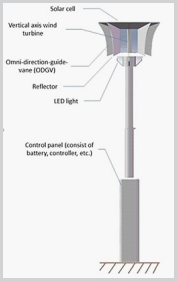
Bronze
Seoul International Invention Fair (SIIF 2013)

Contact

Dr. Chong Wen Tong
Dept. of Mechanical Engineering
Faculty of Engineering
University of Malaya
50603 Kuala Lumpur

Tel : +6012-7235038
Fax : +603-79675317
Email : chong_wentong@um.edu.my

Patent
Filing No.: PI 20090728 & PCT/MY2010/000059, International Publication No.: WO2010098656-A2 / A3



Artist's Impressions

Street Light

Garden Light (night view)

Light House

Compound Light / Garden Light
Comparison between the Eco-Greenergy Outdoor Lighting System and other hybrid wind-solar lighting system