VIDEO ARTICLE

Vid. Proc. Adv. Mater., Volume 2, Article ID 2103160 **(2021)**

Carbon Nanotube Hybrid Material for Air Filtering Applications

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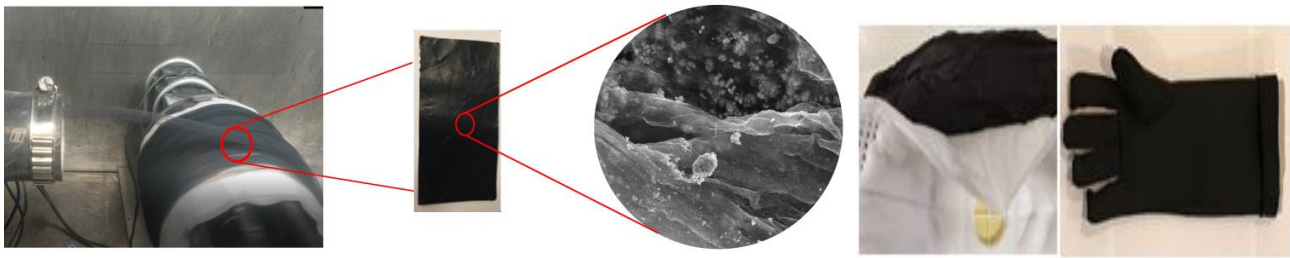
DOI: 10.5185/vpoam.2021.03160

Graphical Abstract



Synthesis of CNT sock | CNT sheet | SEM image of hybrid material | Facemask and Glove filtering applications of CNT hybrid material

Abstract

Carbon Nanotube (CNT) hybrid material is formed by integrating nanoparticles into CNT sheet to improve and customize the properties of the sheet for specific application. The floating catalyst chemical vapor deposition (FCCVD) method was used to synthesize CNT hybrid sheets. In this method, feedstock (a carbon source, catalyst and sulfur as a promoter) is injected from one end of ceramic tube in the high-temperature furnace. The CNT sock or web is collected at the other end of the tube and wrapped on a rotating drum to form a sheet. The FCCVD method is a continuous process and can produce industrial scale CNT sheet. The large surface area and porous nature of the thin CNT sheet or CNT sheet with nanoparticles can be used for filtering applications. The high filtration efficiency and low-pressure drop are key factors for evaluating filter performance. The large surface area of the CNTs allows greater interaction of an aerosol with the sheet compared to other materials. The antibacterial property of the CNTs may be useful for capturing and deactivation of pathogens/virus. This antibacterial property may be improved by incorporating anti-viral nanoparticles into the sheet. A CNT-metal oxide filter membrane composed of silver nanoparticles and CNTs was produced to provide anti-bacterial properties. The metal also acted as a welding agent to bond the CNTs together and changed the surface from hydrophobic to more hydrophilic [**1**]. There

are various ways to integrate nanoparticles in the CNT sheet such as wetting, filling the nanotube shells, or injecting nanoparticles in the synthesis process so that a chemical reaction takes place. In this work, we modified the CNT by injecting nanoparticles during the high temperature synthesis process. The concentration and properties of the CNT hybrid material depends on the synthesis conditions, feedstock composition and carrier gas flow composition. The permeability of the hybrid filter membranes can be customized by the growth time of nanotubes. This membranes produced in a short growth time showed good permeability due to the strong air flow in partially filled channels [**2**]. This presentation discusses synthesis of CNT sheet using the FCCVD method and our approach to integrate nanoparticles in the sheet to improve the properties of the hybrid material. Furthermore, the filtering applications for this hybrid material and the manufacturing obstacles are discussed.

Keywords: Carbon nanotubes, hybrid material; nanoparticles; air filtering.

Acknowledgements

This research study is supported by the National Institute for Occupational Safety and Health (NIOSH) through the Pilot Research Project Training Program of the University of Cincinnati Education and Research Center Grant #T42OH008432.

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Biography of Presenting Author

Megha Chitranshi is currently pursuing a PhD degree in Electrical Engineering at University of Cincinnati. Her research interests include (1) Synthesis of carbon nanotubes from floating catalyst chemical deposition method; (2) Characterization of synthesized carbon nanotube material; and (3) Applications of carbon nanotubes materials. Some of her recent publications include (1) A Review of Three Major Factors Controlling Carbon Nanotubes Synthesis from the Floating Catalyst Chemical Vapor Deposition; (2) Pioneering carbon nanotube textile engineering & fashion technology; (3) Electrochemical activation to enhance the volumetric performance of carbon nanotube electrodes; and (4) Carbon Nanotube Sheet-Synthesis and Applications.

Citation of Video Article

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