Electrical and alcohol sensing properties of PEO/MWCNT composites
Faridah Abdul Razak, Nessrin Awadallah Kattan, and Roslan Md. Nor

Citation: AIP Conf. Proc. 1502, 495 (2012); doi: 10.1063/1.4769168
View online: http://dx.doi.org/10.1063/1.4769168
View Table of Contents: http://proceedings.aip.org/dbt/dbt.jsp?KEY=APCPCS&Volume=1502&Issue=1
Published by the American Institute of Physics.

Related Articles
Magnetic and electrical properties of PbTiO3/Mn-Zn ferrite multiphase nanotube arrays by electro-deposition
Note: Axially pull-up electrochemical etching method for fabricating tungsten nanoprobe with controllable aspect ratio
Effects of carbon nanofillers on enhancement of polymer composites
Improving the field emission of carbon nanotubes by lanthanum-hexaboride nano-particles decoration
Catalyst-free synthesis of reduced graphene oxide–carbon nanotube hybrid materials by acetylene-assisted annealing graphene oxide

Additional information on AIP Conf. Proc.
Journal Homepage: http://proceedings.aip.org/
Journal Information: http://proceedings.aip.org/about/about_the_proceedings
Top downloads: http://proceedings.aip.org/dbt/most_downloaded.jsp?KEY=APCPCS
Information for Authors: http://proceedings.aip.org/authors/information_for_authors
Electrical and Alcohol Sensing Properties of PEO/MWCNT Composites

Faridah Abdul Razak, Nessrin Awadhallah Kattan, and Roslan Md. Nor

Department of Physics, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, MALAYSIA
Email: fdah03@yahoo.com

Abstract. Composites of polyethylene oxide and multiwalled carbon nanotubes were prepared using the solution blending method. Ethanol vapor sensing properties of the composites at different MWCNT loadings were studied. Results on the effect of aligned MWCNT in the composites on the electrical conductivity and alcohol vapor sensing are presented. Field Emission Scanning Electron Microscopy (FESEM) was used to investigate the alignment of PEO/MWCNT.

Keywords: Carbon nanotubes; Nanocomposites; Electrical properties; Polymers.
PACS : 81.07.De

INTRODUCTION

Carbon nanotubes have been shown to be excellent fillers in the fabrication of polymer nanocomposites at much lower loading percentage, compared to particulate fillers such as carbon black [1], where the outstanding properties of carbon nanotubes offer possibilities for developing new strong multifunctional composite materials.
Here, we report a simple method to fabricate MWCNT/PEO composite where the ethanol vapour sensing characteristic was measured. In comparison with other nanofillers, carbon nanotubes are excellent candidates for multi-functional nano-reinforcing a variety of polymer matrices because of their high strength (~100 times stronger than steel) and modulus (about 1TPa), high thermal conductivity (about twice as high as diamond), excellent electrical capacity (1000 times higher than copper), and thermal stability (2800 °C in vacuum) [6]. An insulating polymer into a conducting composite can transform at very low loading because of their extremely high aspect ratio. The electrical behaviour is the most outstanding properties of carbon nanotubes. The electrical conductivity of carbon nanotube composite highly depends on its dispersion, aspect ratio, alignment and the type of polymer used as a matrix.

**MATERIALS AND METHODS**

Dispersed MWCNT at loading of between 1 % to 10 % were added to PEO to form homogeneous composites, dried in the form of sheets where the ethanol vapour sensing properties was investigated. Firstly, all apparatus must be clean. 20 ml of deionised water was thoroughly mixed in 0.5 g of PEO and stirred about 1 hour until it dissolved. 1 % to 10 % of MWCNT was added to 20 ml deionised water. These selected masses are diluted and stirred for 1 hour. Then, all mixtures were placed in an ultrasonic bath for 30 minutes. The samples were heated for 23 °C until the solution was thickened around 6 hours. Printed Circuit Board (PCB) was used to test the resistivity of the samples. Samples were dropped to PCB and tested using gas sensor. The reading of resistance was taken for 500 sec while passing the ethanol gas through the tube. The reaction between nanotubes and other molecules alters the
electrical resistance due to the change in the molecular structure. Carbon nanotube is a new and ideal candidate for gas detection due to the nanometer size, extremely high surface to volume ratio and hollow structure which makes it ideal for gas molecules adsorption. It has been observed that the electrical properties of carbon nanotubes are very sensitive to their chemical environment in which the exposure to gas molecules changes the electrical properties of CNT. These changes attributed to the charge transfer between the molecules and the nanotubes. The gas molecule acts as an electron donors or electron acceptors. Thus, the sensor responses to various gases by decreasing or increasing its resistance. Similar mechanism will be used in fabricating the CNT sensors as chemical detector [7,8]. FESEM was used to study the morphology of the samples.

RESULTS AND DISCUSSION

The electrical response of PEO/MWCNT in Figure 1 shows the comparison of electrical response and recovery curves of the same PEO/MWCNT sheets after exposure to different ethanol flow-rates between 30 sccm and 150 sccm. The results indicate that the sensor sensitivity is increased with increasing flow rate of ethanol vapour. The flow rates at 100 sccm and 150 sccm have almost similar diagram and similar sensing properties which is higher than that when it was exposed to ethanol at 30 sccm and 50 sccm. The higher sensitivity is due to the higher volume of vapour passing through it allowing more gas molecules to react with the nanotube sensor and hence higher electron transfer.
FIGURE 1. Electrical response of PEO/MWCNT sheets at different ethanol flow-rate (a) 30 sccm (b) 50 sccm (c) 75 sccm (d) 100 sccm (e) 150 sccm.

FESEM images of the aligned nanotubes within the polymer matrix in the same magnification are shown in Figure 2. The nanotubes in PEO are homogenously coated with layer of PEO at 5% unaligned MWCNT. Composite film for aligned MWCNT at 10% CNT is shown in Figure 2b.

The grains boundaries reduce the probability of physical contact of MWCNTs which results in less electrons transport through the granular surface.

FIGURE 2. The FESEM images of PEO/MWCNT at the same magnification (a) 5% CNT (b) 10% CNT.
CONCLUSION

Nanocomposites film of PEO/MWCNT was prepared by blending solution which provides good nanotube dispersion in polymer matrix. FESEM was employed to determine the alignment of nanotube within polymer matrix. The sensor sensitivity is increased with increasing flow-rate of the ethanol vapour.

REFERENCES