SYNTHESIS AND CHARACTERIZATIONS OF AMORPHOUS CARBON NANOTUBES/ GOLD PARTICLES HYBRID MATERIALS

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ABSTRACT

Carbon nanotubes (CNT) have attracted great attentions due to its unique properties. However, most works being carried out focus on crystalline CNT. In this work, amorphous CNT (a-CNT) were synthesized successfully via a simple chemical technique at 220 ℃ in a short period of time. Surface morphological studies revealed that as prepared nanotubes present in agglomerated tubular structures with open ends, having diameter of 51.6 nm. The diameter of a-CNT reduced to 40 nm upon functionalization with nitric acid and further reduced to 10.2 nm as treated with auric chloride solution due to introduction of defective sites by these treatments. Both structural and elemental studies confirmed that the nanotubes were carbon and amorphous. From zeta potential measurement, it was found that nitric acid served as the most effective oxidation agent in functionalizing a-CNT with carboxyl groups compared to citric, sulphuric, and hydrochloric acids. Oxidation of nanotubes increased dispersion stability and ensured the successful hybridization between the a-CNT and gold (Au) nanoparticles. Thermal stability of a-CNT decreases with decorations of gold particles on its surface as per findings in Thermogravimetry Analysis (TGA). Electrical conduction are proven to be improved by surface modification where functionalized a-CNT has lower electrical resistivity than as-synthesized a-CNT, and the electrical resistivity decreases significantly with increasing gold content. As-synthesized and modified a-CNT/Epoxy composites exhibits lower electrical resistivity when cured in room temperature compared to 15 ℃, where exception was found on functionalized a-CNT. Through transference number measurement, gold particles are found to contribute to the overall electrical conduction via electron conduction.

ABSTRAK

Nanotube karbon (CNT) telah menarik perhatian yang besar kerana sifat-sifat yang unikn. Walau bagaimanapun, kebanyakan kerja penyelidikan dijalankan memberi tumpuan kepada CNT kristal. Dalam karya ini, CNT amorfus (a-CNT) telah disintesis melalui teknik kimia pada suhu 220 °C dalam tempoh masa yang singkat. Kajian morfologi permukaan mendedahkan bahawa nanotube berstruktur tiub dengan hujung terbuka, berdiameter 51.6 nm. Diameter CNT dikurangkan kepada 40 nm apabila difungsinalisi dengan asid nitrik dan dikurangkan lagi kepada 10.2 nm apabila dikacau dengan larutan klorida Auric disebabkan penambahkan struktur defek dalam process tersebut. Kedua-dua kajian struktur dan unsur mengesahkan bahawa nanotube karbon dan amorfus. Dari potensi zeta, ia telah mendapati bahawa asid nitrik sebagai agen pengoksidaan yang paling berkesan dalam mengfungsinalisi CNT-dengan kumpulan carboxyl berbanding asid sitrik, sulfurik, dan hidroklorik. Pengoksidaan nanotube meningkatkan kestabilan dalam larutan air dan memastikan hibridisasi berjaya antara a-CNT dan nanopartikel emas (Au). Kestabilan haba CNT berkurangan dengan hiasan zarah emas di permukaannya. Kepekatan yang paling optimum larutan klorida emas dalam rawatan satu-CNT untuk mendapatkan sampel haba stabil adalah 7.5 g/dm^3. Konduksi elektrik terbukti dipertingkatkan oleh pengubahsuaian permukaan mana functionalized CNT mempunyai rendah kerintangan elektrik daripada yang disintesis CNT-, dan kerintangan elektrik berkurangan dengan ketara dengan peningkatan kandungan emas. As-disintesis dan komposit a-CNT/Epoxy diubahsuai mempamerkan rendah kerintangan elektrik apabila sembuh pada suhu bilik berbanding 15 ° C, di mana pengecualian telah dijumpai pada functionalized-CNT. Melalui pengukuran bilangan pemindahan, zarah emas didapati menyebabkan pengaliran elektron.

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CNT	Carbon nanotubes
a-CNT	Amorphous carbon nanotubes
SWCNT	Single-walled carbon nanotubes
DWCNT	Double-walled carbon nanotubes
MWCNT	Multi-walled carbon nanotubes
UV-Vis	Ultraviolet-visible
TEM	Transmission electron microscopy
HRTEM	High resolution transmission electron microscopy
FE-SEM	Field emission scanning electron microscopy
XRD	X-ray diffraction
EDX	Energy-dispersive X-ray
FTIR	Fourier transform infrared
TGA	Thermogravimetric analyzer
E_g	Band gap
CVD	Chemical vapour deposition
AAO	Aluminium oxide templates
$Fe(C_5H_5)_2$	Ferrocene
d_{hkl}	Interplanar spacing
hv	Photon energy of the incident light
n	Type of optical transition
B	Constant in Tauc/Davis-Mott model
I_D/I_G	Intensity ration between G and D bands

PUBLICATION

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