SCANNING AND TRANSMISSION ELECTRON MICROSCOPY INVESTIGATION OF MULTIWALL CARBON NANOTUBE/NICKEL OXIDE NANOCOMPOSITE THIN FILMS

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Owing to their unique electronic and optical properties nanocomposite thin films are widely used for converting solar radiation energy into other conventional energy forms, such as heat and electricity[1]. Carbon nanotube-based composites which can be created by mixing relatively small quantities of CNTs with metal oxide (matrix) have been recently used as selective solar absorbers for photo-thermal conversion in a solar collector[2,3]. In this study, multiwall carbon nanotubes (MWCNTs)/Nickel oxide (NiO) nanocomposites were prepared for the first time by a sol-gel process and coated on to aluminium substrate. The MWCNTs were chemically functionalized and then added into NiO alcogels which is followed by magnetic stirring in order to homogeneously disperse in the NiO matrix solution. The surface morphology and detailed microstructure of the thin films was investigated using a ZEISS ULTRA plus FEG-SEM and aJEOL-2100 TEM, respectively.

A typical microstructure of the MWCNTs/NiO composites is seen in Figure 1. Insets (a) and (b) are SEM micrographs of pure NiO nanoparticles and functionalized MWCNTs respectively. As shown in the main figure, the MWCNTs are well dispersed and embedded in the NiO grains. These observations clearly indicate that a good dispersion of MWCNTs in NiO was achieved due to the strong interfacial adhesion between the MWCNTs and NiO matrix.

Figure 2 depicts a typical TEM image of the MWCNT/NiO nanocomposite. Insets (a) and (b) are TEM micrographs of functionalized MWCNTs and pure NiO nanoparticles respectively. It is seen that the MWCNTs are coated with the NiO nanoparticles. The MWCNT/NiO composites have been tested for solar absorption and emission properties. The present materials are able to absorb up to 84% (for single layer) and emit only less than 20% of that solar energy. This is a very competitive result for selective solar absorbers especially when compared to multi-layers reported in literature and also when compared to pure NiO and pure MWCNTs. In conclusion, the sol-gel method was successfully applied to prepare MWCNT/NiO nanocomposite thin films for solar absorbers.

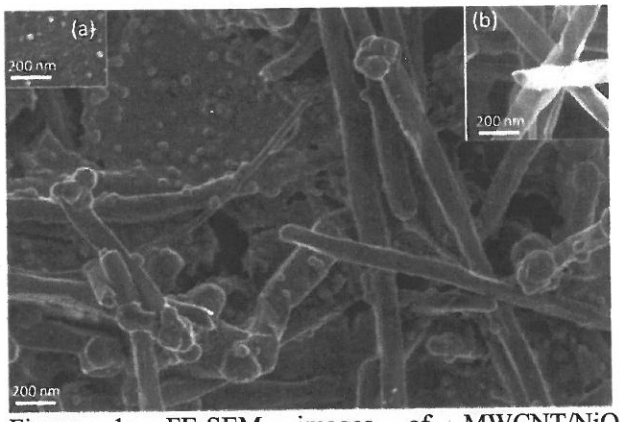

Figure 1. FE-SEM images of MWCNT/NiO nanocomposite coated on aluminium substrate. Inset (a) SEM of pure NiO nanoparticles and inset (b) functionalized MWCNTs.

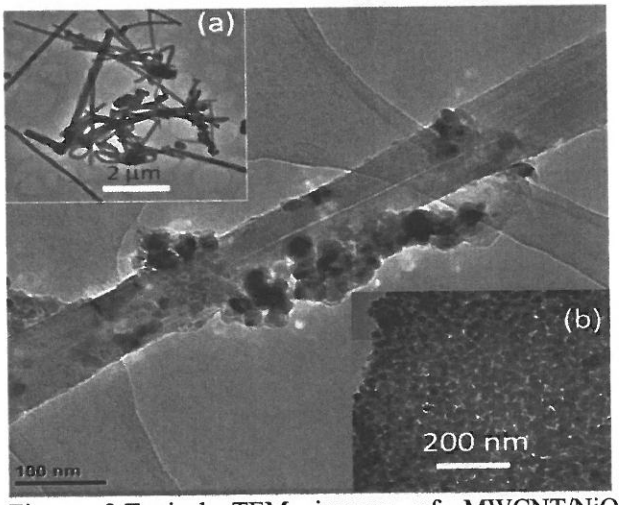

Figure 2.Typical TEM images of MWCNT/NiO composites. Inset (a) functionalized MWCNTs and inset (b) TEM of pure NiO nanoparticles.

References

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