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Preparation and characterization of carbon/nickel oxide nanocomposite coatings for solar absorber applications

Kittessa T. Roro[a,*], Ngcali Tile [a,b] Andrew Forbes [a,b]

[a] CSIR-National Laser Centre, P.O. Box 395, Pretoria 0001, South Africa
[b] School of Physics, University of KwaZulu Natal, Private Bag X54001, Durban 5000, South Africa
[*] Corresponding author. Tel.: +27 128413794; fax: +27 128413152. E-mail address: KRoro@csir.co.za (K.T. Roro).

ABSTRACT

Nanocomposite materials have wide range of applications in solar energy conversion. In this work, C/NiO nanocomposite solar energy absorbing surfaces were prepared using sol–gel synthesis and deposited on aluminium substrates using a spin coater. The coatings were prepared from alcoholic sols based on Ni-acetate using diethalonamine as a chelating agent and polyethylene glycol (PEG) as organic template. Sucrose was used as a carbon source. Sols with different heating temperature and PEG concentrations were fabricated. Thermal analysis on the gel revealed that the xerogels weight loss stabilized at around 430 degrees C. It was found that the absorption edge shifts to the higher wavelength with an increase in the heating temperature in the temperature range studied, 300–550 degrees C, due to an increase in carbon content in the material. The main features of Raman spectra obtained from the composite films are the D and G bands, characteristic of graphitic carbon films. The G peak width narrowed while the ratio of the integrated intensities of the D and G peaks, ID/IG, increased with the heating temperature, suggesting a progressive increase of the graphitic domain within the films. The solar absorption property of the films was enhanced with the increase of PEG concentrations in the sols from 0 to 2 g and decreases with further increase of PEG. The best solar absorption, αsol, and the surface thermal emittance, εtherm, at 100 ◦C obtained were 85% and 5% for a single layer, respectively, yielding an optical selectivity S-αsol/εtherm of 17.1.