Chemical Reduction-Catalytic Vapour Deposition Synthesis of Nickel Oxide-Carbon Nanotubes Composite

CHUKWU, Kenneth Otitonna[1], ABDULRAHMAN, Asipita Salawu[2], ABDULKAREEM, Ambali Saka[3], TIJANI, Jimoh Oladejo[4]

[1]Department of Mechanical Engineering, Federal University of Technology, PMB, 65, Gidan Kwano Campus, Minna, Niger State

[2]Department of Material and Metallurgical Engineering, Federal University of Technology, PMB, 65, Gidan Kwano Campus, Minna, Niger State

[1]Department of Chemical Engineering, Federal University of Technology, PMB, 65, Gidan Kwano Campus, Minna, Niger State

[1]Department of Chemistry, Federal University of Technology, PMB, 65, Bosso Campus, Minna, Niger State

E-mail address: kchukwu96@gmail.com

Phone number: 08034929925

Abstract

In this study, nickel oxide (NiO) nanoparticles were prepared by chemical reductionof nickel(II) chloride hexahydrate as precursor followed by addition of polyethylene glycol and ethanol. Ethanol played a dual role of solvent and secondly as a complementary reducing agent. The effect of solution pH on the size of NiO nanoparticles were investigated. The NiO nanoparticles were immobolized on different amount of carbon nanotubes (CNTs) by wet impregnation and subsequently calcined in a catalytic vapour depsition reactor to give the composite material. The as-prepared composite materials were characterized for their morphology, microstructure, elemental composition, phase structure by High Resolution Scanning Electron Microscope (HRSEM), High Resolution Transmission Electron Microscope (HRTEM), Energy Dispersive Spectroscopy (EDS) and X-ray Diffraction (XRD). The HRSEM micrographs confirmed deposition of metallic nickel particles on the surface layer of the tubular network structure. The XRD analysis revealed that the as-synthesised nanoparticles were pure nickel oxide with rocksalt structure (fcc) crystal structure, with an average dimension of 26.5 nm, 15 nm and 22 nm at pH 7, 9, 11 respectively. The incorporation of carbon nanotubes onto nickel oxide nanoparticles did not destroy the phase structure of the metallic particles. The HRTEM analysis showed that NiO/CNTs have narrow size distribution compared to CNTs alone. The synthetic procedure applied in the present work can be used to obtain high quality NiO/CNTs composite.

Keywords: Synthesis, chemical reduction, nickel-carbon nanotubes, catalytic chemical vapour deposition.