CARBON 48 (2010) 763–773

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/carbon

Tuning the physico-electrochemical properties of novel cobalt (II) octa[(3,5-biscarboxylate)-phenoxy] phthalocyanine complex using phenylamine-functionalised SWCNTs

Bolade O. Agboola [a], *Kenneth I. Ozoemena* [a,*], *Tebello Nyokong* [b], *Takamitsu Fukuda* [c], *Nagao Kobayashi* [c]

[a] *Energy and Processes Unit, Materials Science and Manufacturing, Council for Scientific and Industrial Research (CSIR), Pretoria 0001, South Africa*
[b] *Department of Chemistry, Rhodes University, Grahamstown 6140, South Africa*
[c] *Department of Chemistry, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan*

ARTICLE INFO

Article history:
Received 15 July 2009
Accepted 12 October 2009
Available online 24 October 2009

ABSTRACT

The integration of phenylamine-functionalised SWCNTs (SWCNT-phenylamine) with a novel cobalt (II) octa[(3,5-biscarboxylate)-phenoxy] phthalocyanine (CoOBPPc) complex has been described. The physical and electrochemical properties of the CoOBPPc-SWCNT-phenylamine hybrid were evaluated using spectroscopy (IR and UV–vis), field emission scanning electron microscopy and electrochemistry (cyclic voltammetry and electrochemical impedance spectroscopy). Integration of SWCNT-phenylamine resulted in the physical transformation of the CoOBCPPc from the usually bluish colour of cobalt phthalocyanine complexes to a beautiful bright green colour. In addition, the heterogeneous electron transfer kinetics and electrocatalytic properties of the CoOBCPPc were greatly enhanced following the attachment of the SWCNT-phenylamine. The potential electrocatalytic application of the hybrid was tested using β-nicotinamide adenine dinucleotide (NADH) as a model biological analyte. Interestingly, the onset oxidation potential of this analyte was significantly reduced (300 mV) by this hybrid compared to the bare electrode.

1. Introduction

Metallo-phthalocyanine (MPc) complexes are well known class of N_4-macrocyclic metal compounds with intriguing physical and chemical properties [1–4] and a plethora of technological applications such as sensors and electrocatalysts. One of the current research interests in phthalocyanine chemistries is the integration of carbon nanotubes (CNTs) with MPc complexes (simply called MPc-CNT hybrids) [5,6]. Integration of CNTs with MPc complexes is believed to tune the physico-chemical behaviour of CNTs or MPc complexes to specific potential applications as in sensing, catalysis and electronic devices. CNTs (notably single walled carbon nanotubes (SWCNTs) or multi walled carbon nanotubes (MWCNTs)) have been well established as unique carbon materials with unique physical, chemical and optical properties, excellent electrical conductivity and high mechanical strength [7,8], with ability to enhance electrocatalysis and sensing of various analytes [9–13]. Until now, the integration of CNTs with redox-active transition MPc complexes involved mainly the use of composite mixtures on carbon substrates or covalent integration via self-assembly strategy on gold electrodes [14]. Also, the CNTs used for the studies of such MPc-CNT hybrids mainly utilized those CNTs that have been

* *Corresponding author*: Fax: +27 12 8412135.
E-mail address: kozoemena@csir.co.za (K.I. Ozoemena).
0008-6223/$ - see front matter
doi:10.1016/j.carbon.2009.10.023