Development of selective chloroform sensor with transition metal oxide nanoparticle/multi-walled carbon nanotube nanocomposites by modified glassy carbon electrode

By: Rahman, MM (Rahman, Mohammed M.)[1,2] ; Balkhoyor, HB (Balkhoyor, Hasan B.)[1] ; Asiri, AM (Asiri, Abdullah M.)[1,2] ; Sobahi, TR (Sobahi, Tariq R.)[1]

View ResearcherID and ORCID

JOURNAL OF THE TAIWAN INSTITUTE OF CHEMICAL ENGINEERS
Volume: 66 **Pages:** 336-346
DOI: 10.1016/j.jtice.2016.06.004
Published: SEP 2016
View Journal Impact

Abstract

Transition metal oxide (NiO) nanoparticles decorated multi-walled carbon nanotubes (NiO/MWCNT nanocomposites, NCs) were prepared by a facile solution method using reducing agents in alkaline medium. The NiO/MWCNT NCs were characterized by UV/vis, FT-IR, energy-dispersive X-ray spectroscopy (XEDS), powder X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM), and scanning electron microscopy (TEM). The NiO NPs or NiO/MWCNTs were deposited separately on flat glassy carbon electrode (GCE) with conducting binders (5% nafion) to result in a sensor that has a fast response towards selective chloroform (CHCl3). Features including high-sensitivity, lower-detection limit, reliability, reproducibility, ease of integration, long-term stability, selective, and enhanced electrochemical performances are investigated in details. It is detailed studied the sensor performances with NiO NPs/GCE and NiO/MWCNT/GCE electrodes separately and found that NiO/MWCNT/GCE exhibits the higher sensitivity and lower detection limit compared to NiO/GCE assembly. The calibration plot is linear (r(2) = 0.9763) over concentration range (3.5 nM to 35.0 mM) with NiO/MWCNT/GCE. The sensitivity and detection limit was calculated for NiO/MWCNT/GCE as similar to 917.7 nA/cm(2) mu M and 0.1034 +/- 0.0002 nM (at a signal-to-noise-ratio, SNR of 3) respectively. Finally, the efficiency of the proposed chemi-sensors can be applied and effectively utilized for the detection of toxic chloroform compound in environmental and healthcare fields in broad scales.

Keywords

Author Keywords: NiO/MWCNT nanocomposites; Optical properties; Glassy carbon electrode; Structural properties; Chloroform detection; I-V method

KeyWords Plus: NICKEL-OXIDE; GAS SENSORS; PERFORMANCE; FABRICATION; PYROLYSIS; COMPOSITE; GLUCOSE; POWDER

Author Information

Reprint Address: Rahman, MM (reprint author)

King Abdulaziz Univ, Fac Sci, Dept Chem, POB 80203, Jeddah 21589, Saudi Arabia.
Organization-Enhanced Name(s)
King Abdulaziz University

Addresses:

[1] King Abdulaziz Univ, Fac Sci, Dept Chem, POB 80203, Jeddah 21589, Saudi Arabia
Organization-Enhanced Name(s)
King Abdulaziz University

[2] King Abdulaziz Univ, CEAMR, POB 80203, Jeddah 21589, Saudi Arabia
Organization-Enhanced Name(s)
King Abdulaziz University

E-mail Addresses: mmrahman@kau.edu.sa

Funding

Funding Agency	Grant Number
Center of Excellence for Advanced Materials Research (CEAMR), King Abdulaziz University, Saudi Arabia	

View funding text

Publisher

ELSEVIER SCIENCE BV, PO BOX 211, 1000 AE AMSTERDAM, NETHERLANDS

Categories / Classification

Research Areas: Engineering

Web of Science Categories: Engineering, Chemical

Document Information

Document Type: Article

Language: English

Accession Number: WOS:000382340200037

ISSN: 1876-1070

eISSN: 1876-1089

Other Information

IDS Number: DU6QR

Cited References in Web of Science Core Collection: 49

Times Cited in Web of Science Core Collection: 0