Superlattices and Microstructures 50 (2011) 437–448

Contents lists available at SciVerse ScienceDirect

Superlattices and Microstructures

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

Synthesis and physical properties of mixed Co_3O_4/CoO nanorods by microwave hydrothermal technique

Reem M. Al-Tuwirqi [a], A.A. Al-Ghamdi [a], Faten Al-Hazmi [a], Fowzia Alnowaiser [b], Attieh A. Al-Ghamdi [c], Nadia Abdel Aal [d], Farid El-Tantawy [e,*]

[a] Department of Physics, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia
[b] Department of Chemistry, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia
[c] King Abdulaziz City for Science and Technology, Electronics, Communications, and Photonics Program, Riyadh, Saudi Arabia
[d] Department of Chemistry, Faculty of Science, Suez Canal University, Ismailia, Egypt
[e] Department of Physics, Faculty of Science, Suez Canal University, Ismailia, Egypt

ARTICLE INFO

Article history:
Received 18 March 2011
Received in revised form 30 May 2011
Accepted 29 June 2011
Available online 17 September 2011

Keywords:
Nanorods cobalt oxide
Microwave hydrothermal synthesis
Microstructure and optical
Electrical and magnetic properties

ABSTRACT

A mixture of crystalline Co_3O_4/CoO nanorods with non-uniform dense distribution has been successfully synthesized by microwave hydrothermal technique. The synthesized nanorods have been characterized by several techniques such as X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDX), and Fourier transforms infrared spectroscopy (FT-IR). The results showed that the as synthesized specimens contained mixed crystalline Co_3O_4/CoO nanorods with an average length of around 80 nm and an average diameter of 42 nm. UV–Vis spectrum of the nanorods exhibited a strong UV emission. The band energy gap of the product was 1.79 eV which lies between the energy gap of CoO and that for Co_3O_4. The obtained carrier concentration is of the order 4.32×10^{27} m^{-3} and the dielectric constant is found to be 4.89. The electrical conductivity increases with increasing temperature and behaves as a semiconducting material with an activation energy of a bout 0.26 eV. This makes the as synthesized mixed Co_3O_4/CoO nanorods very useful for supercapacitor devices application. Magnetic hysteresis loops at room temperature of the as synthesized mixed oxides (Co_3O_4/CoO) nanorods exhibit typical soft magnetic behavior.

* Corresponding author.
E-mail address: faridtantawy@yahoo.com (F. El-Tantawy).

0749-6036/$ - see front matter © 2011 Published by Elsevier Ltd.
doi:10.1016/j.spmi.2011.06.007