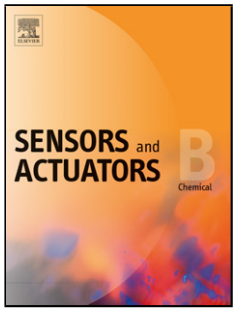

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PII: S0925-4005(15)30387-7
DOI: http://dx.doi.org/doi:10.1016/j.snb.2015.09.080
Reference: SNB 19065

To appear in: *Sensors and Actuators B*

Received date: 4-6-2015
Revised date: 16-8-2015
Accepted date: 15-9-2015

Please cite this article as: D. Yan, S. Li, M. Hu, S. Liu, Y. Zhu, M. Cao, Electrochemical synthesis and the gas sensing properties of the Cu2O nanofilms/porous silicon hybrid structure, *Sensors and Actuators B: Chemical* (2015), http://dx.doi.org/10.1016/j.snb.2015.09.080

Electrochemical synthesis and the gas sensing properties of the Cu_2O nanofilms/porous silicon hybrid structure

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Abstract

A novel composite of Cu_2O nanofilms/porous silicon hybrid structure has been successfully synthesized using porous silicon as growth substrate by electrochemical synthesis. Orderly porous silicon (PS) substrate with the aperture about 1.5μm and hole depth about 10μm was prepared by electrochemical etching of a p-type monocrystalline silicon wafer in a double-tank cell. The Cu_2O nanofilms have been grown onto PS substrates by electrochemical deposition with different electrodeposition time. The obtained Cu_2O nanofilms/PS products were investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscope (TEM). The gas sensing properties of Cu_2O nanofilms/PS composites to NO_2 were studied by the gas sensing test system. The result indicates that the electrodeposition time has a significant impact on the microstructure and gas sensing properties of Cu_2O nanofilms/PS composites. Due to the high specific surface area and special microstructure, the Cu_2O nanofilms/PS gas sensor with the eletrodeposition time of 30 min showed good gas sensing properties to NO_2 with a high gas response, fast response-recovery characteristic, excellent repeatability and good selectivity at a working temperature of 175°C. At the working temperature, the gas sensor has a gas response of about 4.5 to 1 ppm NO_2. The related gas sensing mechanism will be discussed.

Keywords

Cuprous oxide; Nanofilms; Porous silicon; Electrochemical deposition; Gas sensor

1. Introduction

Nitrogen dioxide (NO_2) is one of the most toxic gases in the atmosphere which results from combustion and automotive emission[1]. According to the Italian regulation, the air-quality standard for NO_2 of attention level in the ambient air is 100 ppb for long-term exposure[2]. Therefore, the development of detector for NO_2 has attracted intensive attention. The NO_2 gas sensors with some characteristics such as a high gas response, short response-recovery time, low power consumption and low cost are demanded, but not yet marketed.

Porous silicon (PS) is an important porous medium which is sensitive to many gases such as