OPTICAL AND SENSORY PROPERTIES OF ZnO NANOFIBROUS LAYERS GROWN BY MAGNETRON SPUTTERING

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This paper presents optical and sensory properties of ZnO nanofirous layers grown by a cost-effective and fast fabrication method based on magnetron sputtering. The as-prepared layers were characterized by scanning electron microscopy, energy dispersive X-ray spectrometry, X-ray diffraction, photoluminescence, and sensing testing. The as-prepared nanofibrous layers show good conductive properties which are of interest for gas sensing structures. Their application for hydrogen detection is demonstrated in premiere, and the developed H_2 sensor structure exhibits good response/ recovery behaviour under ultraviolet (UV) light, and good sensitivity. This method is cost-effective and facile and has a great potential for various applications.

ZnO nanofibrous, magnetron sputtering, photoluminescence, XRD, UV, sensor.

1. INTRODUCTION

Zinc oxide (ZnO) is a key functional material exhibiting near-ultraviolet emission, semiconducting, magnetic, and piezoelectric properties. Thus, ZnO is one of the metal oxides with wide-band gap that are of great interest for versatile applications [1]. Recently, the studies of ZnO nanoscale morphologies gave an impetus to applications in electronic and optoelectronic devices based on large surface-to-volume ratios. [1-4]. Zinc oxide nanowires, nanorods, tetrapods clearly demonstrate utility of such nanomaterial in light emitting diodes, sensor and UV photodetectors [1-5]. Among different morphologies, nanofibrous layers have attracted more attention recently due to their high specific surface area and porous structures [6]. Usually, the gas sensing properties of oxide semiconductors strongly depend on the contact surface of these nanomaterials [7]. Thus, investigations of novel approaches to improve sensor performances are in the focus of researchers. The ZnO nanostructures have been fabricated by several growth methods, like hydrothermal synthesis [8], vapor-liquid-solid (VLS), vapor-solid (VS) [9] processes, metal-organic chemical vapor deposition [10], chemical vapor deposition [11], etc. The magnetron sputtering technique has been widely used to synthesize ZnO films [12], but no nanofibrous morphologies have been evidenced so far.

In this paper, we show the optical and sensing performances of ZnO nanofibrous material fabricated by magnetron sputtering method with controllable surface morphology. We report the hydrogen sensing ability of ZnO nanofibrous layers. The developed sensor structures exhibited good sensitivity to H_2 gas under UV light pulse.

2. EXPERIMENTAL

Zinc oxide nanofibrous material was prepared by following the procedure described elsewhere [13]. Briefly, the main parameters of the magnetron sputtering techniques are the discharge current, voltage, the cathode power, the gas pressure in the working chamber and magnetic induction.