Journal of ELECTRONIC MATERIALS, Vol. 48, No. 1, 2019
https://doi.org/10.1007/s11664-018-6756-x

Gas Sensing Properties of Hydrothermally Synthesized Button Rose-Like WO_3 Thin Films

M.S. PATIL,[1] V.L. PATIL,[2] N.L. TARWAL,[2] D.D. MORE,[1] V.V. ALMAN,[1] L.D. KADAM,[3] P.S. PATIL,[1,2,5] and J.H. KIM[4,6]

1.—School of Nanoscience and Biotechnology, Shivaji University, Kolhapur, M.S. 416004, India. 2.—Thin Film Materials Laboratory, Department of Physics, Shivaji University, Kolhapur, M.S. 416004, India. 3.—Solid State Physics Laboratory, Department of Physics, Yashvantrao Chavan Institute of Science, Satara, Maharashtra 415001, India. 4.—Department of Materials Science and Engineering, Chonnam National University, Gwangju 500757, South Korea. 5.—e-mail: patilps_2000@yahoo.com. 6.—e-mail: jinhyeok@chonnam.ac.kr

In this paper, we have synthesized the WO_3 button rose-like morphology directly grown on glass substrate using NaOH as an etching agent by hydrothermal method at 100°C. The formation of the WO_3 button rose and its structural, optical, surface morphological and electrical properties were studied by various characterization techniques. The button rose-like morphology and orthorhombic crystal structure were confirmed by scanning electron microscopy (SEM) and x-ray diffraction techniques (XRD), respectively. The optical spectroscopy measurements reveal the band gap energy of WO_3 button rose-like morphology varied between 2.2 and 2.4 eV. It is seen that the button rose-like morphology plays a crucial role in gas sensing properties. The as-synthesized WO_3 button rose shows a gas response of about 262% at 6 ppm of NO_2 gas. Particularly, this gas sensor shows better gas sensitivity towards NO_2 gas than the other gases. Because of the high value of gas sensitivity, the reported WO_3 with button rose-like morphology could be a suitable candidate for NO_2 sensing.

Key words: WO_3 button rose, hydrothermal method, Etching agent: NaOH, NO_2 gas sensor

INTRODUCTION

In the modern era, rapid industrial growth and economic development have become the major concerns due to emission of hazardous and toxic gases on a large scale.[1] The most serious issue is related to human health and the ecosystem present in this biosphere. Air pollution rate is increasing daily due to the release of a high amount of gas exhaust from different industrial processes. The different harmful gases such as NH_3, H_2S, NO_2, H_2, SO_2 are emitted through different sources.[2,3] Among these gases, NO_2 is responsible for acid rain, photochemical smog and many health hazards.[4] This highly toxic gas is generated from different sources such as combustion of fuel, home heaters and through the automobile engine processes.[5]

Nowadays, it has become very essential to monitor these issues by using high-quality gas sensor devices. For gas sensing, metal oxides become very popular materials due to their cost-effectiveness, simple fabrication, and compatible properties. The nanostructured metal oxides have become most interesting due to their amazing properties copared to their bulk form. In recent research, the morphologically controlled materials are fabricated due to its properties and working ability strongly related to its shape, size and a high surface area in nanostructures.[6] Morphology plays a vital role in tuning the surface area and, therefore, the high performance of gas sensing devices. There are many reports based on fabricating the vivid architectures

(Received March 17, 2018; accepted October 24, 2018; published online October 30, 2018)