



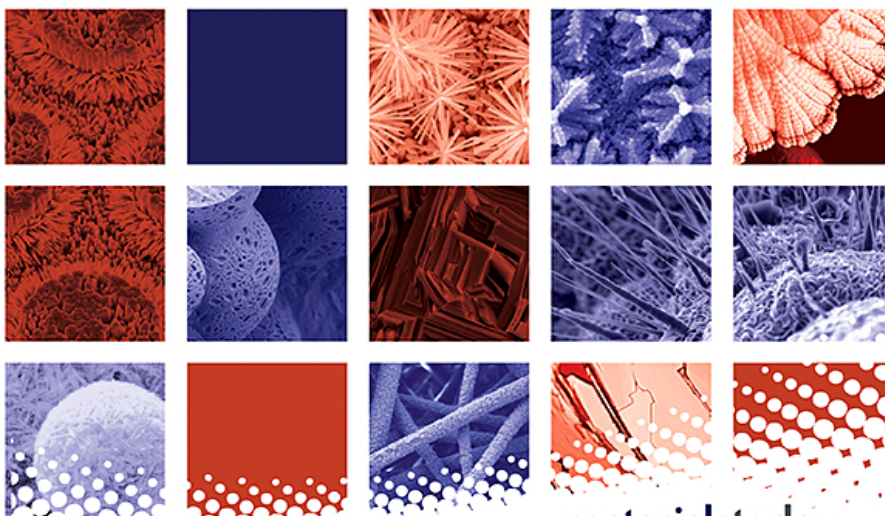
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Investigations on structural, optical and electrical properties of microwave-assisted reduced graphene oxide:Zinc oxide nanocomposite thin films

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Abstract

The reduced graphene oxide:Zinc oxide (rGO:ZnO) nanocomposite optimized wet-chemical sol-gel derived spin-coating method and microwave-assisted approach was adopted for the reduction of rGO on the microstructural and optoelectronic properties of ZnO with various ratios of rGO. The results showed significant changes in the microstructural and optical properties of the rGO:ZnO composite films. X-ray diffraction analysis of the composite films with a preferential growth orientation was observed. Good optical transparency in the visible wavelength region was observed. As the weight percentage of rGO increased from 0% to 20%, the band gap was noticed, indicating the weak Burstein-Moss effect. The optical absorption of rGO increases, resulting in the reduction of transmittance and therefore the resistivity of the composite film. The lowest values of sheet resistance and resistivity were recorded for 10% rGO:ZnO composite film. The obtained ZnO matrix composite film could be a potential candidate for electrode a

Introduction

Metal oxide nanomaterials with diverse compositions and rich environment and energy fields. Among them, zinc oxide (ZnO) and is extensively studied due to its intriguing properties, with low cost, a direct energy wide band gap (3.37 eV), high chemical exciton binding energy (60 meV). ZnO is widely used as transparent electrical devices such as organic light-emitting diodes (OLED) solar cells [1], [2], [3], [4]. Several studies have shown that ZnO its mobility, optical and magnetic properties, donor and acceptor. Further, several efforts have also been made to modify the properties with graphene oxide (GO) and reduced graphene oxide (rGO) for device application [7], [8], [9], [10]. GO is a one-atom-thick and epoxide groups on its basal plane and carboxyl groups on the carbon structure with a mixture of sp^2 and sp^3 hybridized carbon functional groups in graphene oxide also makes it a very chemically energy gap manipulation by simple chemical methods [11]. It enables it to form a stable and homogeneous dispersion in water [12]. For the reduction of GO, chemical, thermal, optical have been used. Recently, the microwave reduction technique has been used since microwave heating depends on the absorption characteristics of the material. This method is more because the substance can be heated uniformly and effectively without mechanical stirring. In the present work, the GO is reduced by the composite films of rGO:ZnO was fabricated using an optical method. the role of rGO on the structural and optoelectronic properties

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Section snippets

Preparation of GO and rGO

A modified Hummer's method was used to prepare GO from purchased from SDFCL. For the synthesis, 1 g of the natural graphite conical flask along with conc. H_2SO_4 (98% pure from Merck Chemicals) was gradually added while being stirred in an ice-water explosion. The mixture was diluted by adding 150 ml of distilled water and stirred with a magnetic stirrer for 6 h at...

Structural study

The crystalline structure of pure ZnO and rGO:ZnO composite films. Figure 1 shows the diffractogram of ZnO and rGO:ZnO composite films. The composite films exhibit significant diffraction peaks corresponding to the ZnO phase, showing that the ZnO thin films are polycrystalline and have a hexagonal wurtzite structure (JCPDS File No. 36-1451, $a=b=3.249 \text{ \AA}$, $c=5.206 \text{ \AA}$). However, after int

Conclusion

In summary, the rGO:ZnO composite thin films were fabricated using an effective, sol-gel derived, spin coating technique. A simple, facile approach was used for the reduction of the graphene oxide. The high polycrystallinity of the rGO:ZnO composite thin films with high c-axis orientation confirmed the preferable c-axis orientation of the crystallites. The optical...

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CRedit authorship contribution statement

N. Rashmi: . F.J. Serrao: . V.S. Kindalkar: . K. Kumara: . N.B. Rithin Kumar: . G. D'sa: Formal analysis, Investigation, Methodology, Writing

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or relationships that could have appeared to influence the work reported in this paper.

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