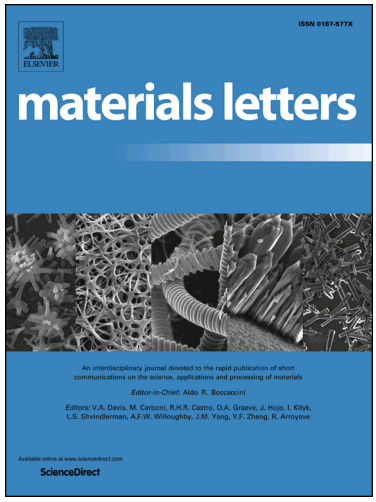

Influence of pH Value on Structural, Optical and Photoresponse Properties of SnS Films Grown via Chemical Bath Deposition

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Influence of pH Value on Structural, Optical and Photoresponse Properties of SnS Films Grown via Chemical Bath Deposition

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Abstract

For the first time, the influence of fine variation of pH value of the chemical bath (6.5, 7.0 and 7.5) on structure, morphology, optical and photoresponse of SnS films was investigated. X-ray analysis revealed that the structure undergoes orthorhombic-to-cubic phase transformation at pH 7.0. Furthermore, a significant reduction in dark current value of photodetector, from μA to nA, occurred following this phase transformation. Under illumination of near infrared 750 nm, the photoresponse exhibited by the photodetector based on cubic structure was found to be faster 8 times compared to that based on orthorhombic structure, while the photosensitivity was 2.7 times higher. The estimated band gap energy of films lies between 1.51 -1.73 eV with increasing pH value. The obtained results demonstrated the crucial role of fine pH value on the characteristics of nanostructured SnS films.

Keywords: Thin Films; pH; Crystal Structure; Near infrared; Photosensitivity; Photodetector.

1. Introduction

Tin sulfide (SnS) material belongs to IV–VI group metal chalcogenides that have attracted great interest in recent years [1]. It has been proposed as potential candidate for optoelectronic devices, because of its numerous advantages such as naturally abundant, cheap, and heavy-metal-free (i.e., free from Pb, and Cd) [2]. Furthermore, SnS has an appropriate band gap (1.0 –1.6 eV) and high absorption coefficient ($> 10^4$ cm^{-1}) [1]. The pH of the reaction solution has been identified as an important parameter in chemical bath deposition (CBD) because it directly affects the mechanisms of nucleation and particle growth of films onto substrates. Hence, it can influence the structure, morphology, optical and photoresponse characteristics of films grown through CBD. Based on literature review of CBD, there is only one paper reporting on the effect of pH value (5 and 6) on the structure (zinc blende and orthorhombic) and photoresponse of SnS films. However, the reported