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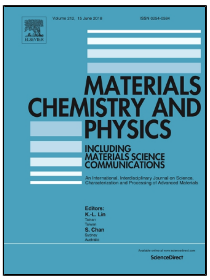

Preparation of n-type Copper Gallium Selenide thin films by tin doping and analysis of its structural, electrical, optical and transport properties

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ACCEPTED MANUSCRIPT

Preparation of n-type Copper Gallium Selenide thin films by tin doping and analysis of its structural, electrical, optical and transport properties

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Abstract

This paper reports doping with tin as a successful technique to induce n-type conductivity in Copper gallium selenide , which is established as an inflexibly p-type material, thus opening up new avenues in its optoelectronic applications. The conductivity type has been confirmed by multiple characterizations employing hot probe, Hall and thermopower measurements. The structure, composition and morphology of the films are well characterized by X-Ray Diffraction, Raman Spectra, Energy Dispersive Analysis by X-Rays, X-Ray Photoelectron Spectroscopy and Scanning Electron Microscopy. Optical analysis gives the fundamental bandgap as 1.55±0.03eV which is lower than that of undoped CGS. The conductivity mechanisms prevailing in the low temperature range of 100-170K is the Seto's grain boundary model with the barrier height estimated as 80±4meV and Arrhenius thermal activation in the range of 185-300K with activation energy of 120±6meV attributed to Se vacancies. The activation energy calculated in the temperature range 350-473K is 470±28 meV which is due to tin on gallium site donor level formation. Thus achievement of n-type conductivity is attributed to the uncompensated donor level formations when Sn^{4+} takes the position of Ga^{3+} and to Se vacancies.

Keywords : Thin films, vacuum coevaporation, n-type conductivity, optical bandgap, Conductivity mechanisms

1. Introduction

The accelerated depletion of conventional energy sources like fossil fuel has led to active research in sourcing of sustainable energy alternatives in a cost effective format[1-3]. In the wake of solar energy being identified as a potential alternative considering its perennial

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