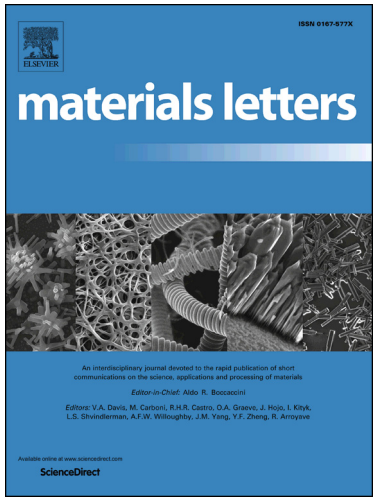
Accepted Manuscript



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PII: S0167-577X(17)30910-2
DOI: http://dx.doi.org/10.1016/j.matlet.2017.06.028
Reference: MLBLUE 22740

To appear in: *Materials Letters*

Received Date: 15 April 2017
Revised Date: 2 June 2017
Accepted Date: 5 June 2017

Please cite this article as: S. Dridi, N. Bitri, M. Abaab, Synthesis of quaternary Cu_2NiSnS_4 thin films as a solar energy material prepared through «Spray» technique, *Materials Letters* (2017), doi: http://dx.doi.org/10.1016/j.matlet.2017.06.028

Synthesis of quaternary Cu_2NiSnS_4 thin films as a solar energy material prepared through « Spray » technique

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Abstract

Cu_2NiSnS_4 (CNTS) is considered as a promising quaternary semiconductor, suitable for absorber layer in thin film solar cells because of their non toxic and earth-abundant elements. Here, we have successfully deposited CNTS thin films onto glass substrates by the Spray Sandwich method. These thin films were only obtained at substrate temperature 300 °C with 60 min spray duration. The prepared CNTS thin films exhibited high absorption coefficient (~10^4 cm^{-1}) in the visible region with direct band gap energy of 1.23 eV, suggesting its potential use in thin film solar cells.

Keywords: Thin films, Cu_2NiSnS_4, Solar energy material, Spray Sandwich.

1. Introduction

Recently, quaternary chalcogenide semiconductors Cu_2XSnS_4 (X= Ni, Zn, Co, Mn, Fe) have drawn a lot of attention as an absorber for applications in thin-film solar cell devices because of excellent optical, electrical and chemical properties. Among them, Cu_2NiSnS_4 (CNTS) thin film is considered as one of the promising candidates for low-cost thin films solar cells. Indeed, this semiconductor exhibits suitable band gap energy of 1.1-1.5 eV and high absorption coefficient about (~10^4 cm^{-1}) [1]. There are few reports concerning the preparation of CNTS based thin films. Yang et al. synthesized CNTS thin films with a stannite structure by a facile one-step electro-deposition method followed by the annealing treatment which realized in H_2S/N_2 mixed at atmosphere [2]. Chen et al. fabricated CNTS thin films with a cubic structure using an electro-deposition method followed by sulfurization at high temperature [3]. Based on CNTS thin films, only electro-deposition method has been used.

We report, for the first time, the fabrication of cubic CNTS thin films using a Spray Sandwich method without any annealing treatment. In fact, the Spray Sandwich method is an advanced chemical