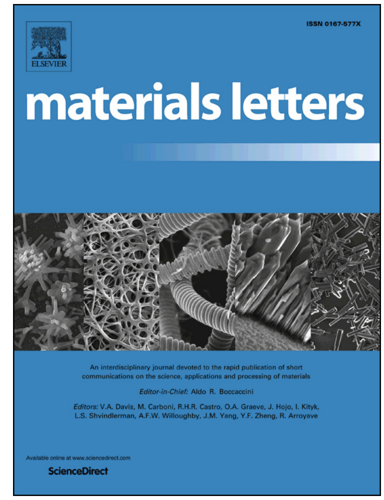
Accepted Manuscript



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PII: S0167-577X(18)31287-4
DOI: https://doi.org/10.1016/j.matlet.2018.08.074
Reference: MLBLUE 24785

To appear in: *Materials Letters*

Received Date: 4 May 2018
Revised Date: 15 August 2018
Accepted Date: 16 August 2018

Please cite this article as: S. Das, K. Sa, I. Alam, P. Mahanandia, Synthesis of CZTS QDs decorated reduced graphene oxide nanocomposite as possible absorber for solar cell, *Materials Letters* (2018), doi: https://doi.org/10.1016/j.matlet.2018.08.074

Synthesis of CZTS QDs decorated reduced graphene oxide nanocomposite as possible absorber for solar cell

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KEYWORDS: Cu_2ZnSnS_4; Quantum dots; nanocomposite; XPS; Raman

Abstract

Herein, preparation of Cu_2ZnSnS_4 (CZTS) quantum dots (QDs) decorated reduced graphene oxide (rGO) nanocomposite by a simple and nontoxic solution method is reported. Structure and morphology of CZTS QDs, rGO and prepared composite have been analysed through XRD, TEM, Raman, XPS, UV-Vis and FESEM. Improvement in current in CZTS QDs-rGO composite compared to CZTS QDs could be attributed to the separation of electron-hole pairs generated in QDs and their rapid transfer to the surface of graphene sheets. This result suggests that the prepared composite could be used as promising materials for solar cell.

1. Introduction

Solar energy converted by photovoltaic cells (PVCs) into electrical energy is a good choice of green and renewable resources. Though silicon based PVC is dominating with power conversion efficiency (PCE) ~25%, it suffers from low absorption cross section and high cost manufacturing and installation. Other competitive light absorbing materials like cadmium telluride (CdTe), copper indium gallium selenide (CIGS) have gained rapid commercial market share. However, the scarcity and toxicity of Te, In, Ga and Cd elements limit their usage in PVC. Cu_2ZnSnS_4 (CZTS), a p-type semiconductor with tunable band gap (E_g=1-1.65eV) and high absorption coefficient $10^4 cm^{-1}$ includes earth abundant and non-toxic constituents is considered as an alternative absorber material in PVCs [1]. Theoretically predicated Shockley-Queisser limit for CZTS PVCs is 32.2%, but with the existing technology obtained PCE for CZTS thin films based PVC is in the range from 0.66% to 12.6% in which UV photon energy is wasted as heat [2,3].

In order to make use of UV photon**,** semiconducting quantum dots (QDs) with dimension smaller than exciton Bohr radius, have emerged as efficient light harvesting material owing to their size-tunable optical properties, quantum-confinement effect and ability to generate multiplex electron-hole pairs and achieve higher PCE beyond Shockley-Queisser limit [4].