Perspectives on the merits of cubic silver antimony sulfide-selenide thin films for solar cells

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Abstract

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- The silver antimony sulfide-selenide – cubic-$AgSb(S, Se)_2$ is a potential p-type semiconductor for application in thin-film solar cells. In this work, we present perspectives of $AgSb(S, Se)_2$ to develop high-efficiency solar cells using this cubic metal chalcogenide semiconductor.

- Material characterization of the $AgSbS_{1.3}Se_{0.7}$ solid solution confirms p-type conductivity with a bandgap of 1.48 eV and photoconductivity (σ) of $10^5\ \Omega^{-1}\mathrm{cm}^{-1}$.

- The merit of incorporating silver atoms into the novel antimony chalcogenides (Sb_2S_3, Sb_2Se_3) comes from the transformation of orthorhombic structure into an FCC lattice, similar to that in rock salt structure.

- The absorption coefficient of $\alpha > 10^5\mathrm{cm}^{-1}$ in the visible region of solar radiation in $AgSbS_{1.3}Se_{0.7}$ allows a maximum photo-generated current density of 29 $\mathrm{mA}/\mathrm{cm}^2$ for a 1 $\mu\mathrm{m}$ thick film under standard air-mass 1.5 global (1000 W/m2) solar radiation.

- The thin film solar cells of CdS/$AgSbS_{1.3}Se_{0.7}$ heterojunction presents a fill factor of 0.64, open-circuit voltage of 537 mV, but a low short circuit current density of 2 mA/cm^2.

- At this stage, chemical deposition has served for prototyping the solar cells. Improvements are expected using industrial chalcogenide growth techniques, which would enhance their carrier collection.

- $\sqrt{a+b^2}$

- $\sigma = 2 \times 10^{-8}\,\Omega^{-1}cm^{-1}$

Introduction

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