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Chalcogen incorporation in Cu(InGa)(SeS)/sub 2/ coevaporated thin films

Publisher: IEEE

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Abstract:

Thin films of Cu(InGa)(SeS)/sub 2/ have been deposited by elemental coevaporation. Characterization of the relative incorporation of S and Se in the film as a function of the S/(S+Se) content in the vapor shows that S is preferentially incorporated in a Cu-rich film, whereas Se is preferentially incorporated into a Cu-poor film. In most cases, a film with a single phase can not be deposited. Cu-rich films have a CuS layer on top of a chalcopyrite layer. Many Cu-poor films have a layered chalcopyrite structure with a composition that approximates the vapor composition on the bottom, and a composition richer in Se at the surface. Mechanisms for this vertically segregated behavior are discussed with respect to relative S and Se incorporation.

Published in: Conference Record of the Thirty-first IEEE Photovoltaic Specialists Conference, 2005.

Date of Conference: 03-07 January 2005

DOI: 10.1109/PVSC.2005.1488115

Date Added to IEEE Xplore: 08 August 2005

Publisher: IEEE

Print ISBN:0-7803-8707-4

Conference Location: Lake Buena Vista, FL, USA

References is not available for this document.

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INTRODUCTION

The addition of S or Ga to the CuInS_2 crystal structure provides a pathway for the growth of wider bandgap films. Films with bandgaps greater than 1.5 eV have not, as yet, matched the performance of lower bandgap cells, but may lead to improved module performance and are needed for a top cell in a multijunction cell based on this material system. The uniform addition of both Ga and S to the same film increases the range of bandgaps that can be obtained, and may provide a way of overcoming the drawbacks of using only one of them. It is important to try to understand the basic material properties of this pentenary material system as well as the thermodynamics and kinetics of phase formation under different growth conditions.

Authors



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