Controlled crystallization of PLD amorphous CZTS thin film for photovoltaic application

Juguang Hu*[1], Guangxing Liang , Huo Xiao , Zhenghua Su , Ping Fan† , and Xiaodong Lin‡

[1]Hu juguang – Institute of Thin Film Physics and Applications, College of Physics and Energy, Shenzhen University, 518060 Shenzhen, China, China

Abstract

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With non-toxic and earth-abundant elements, kesterite-based Cu2ZnSnS4 (CZTS) semiconductor materials have been extensively explored as an alternative to overcome the large scarcity or toxicity issue of current CuInGaSe2 and CdTe. The highest power conversion efficiency of solar cells based on CZTS materials has been hovering around 9.2 % which are significantly lower than that of CIGS (22.6%) and CdTe (22.1%), mostly because of low open circuit voltage (Voc). Thus, a lot of efforts have been executed to decrease Voc deficit, especially the controlled crystallization of CZTS amorphous thin film, including the phase formation dynamics during processing, annealing, or re-crystallization. [1]

In this work, we report the thermal induced crystallization and performance of CZTS thin films prepared by puled laser deposition (PLD)[2]. Firstly, the flat, compact and uniform amorphous CZTS thin film with stoichiometric can be prepared by our optimized PLD method. Then the influence of post-sulfur annealing temperature on the microstructure, composition, the electrical and optical properties of CZTS thin films has been established. Well-crystallized CZTS films at 600∘C showed the compact grains with a bandgap of 1.48eV and a high absorption coefficient of 105 cm-1 in the visible region. These interesting features have been used in the prototype photovoltaic devices with a conversion efficiency of 4.2 %. These are the first results concerning the use of our optimized PLD CZTS films for photovoltaic application and further improvement of device performance is expected.[3]

Kaur Kulwinder, Kumar Naveen, Kumar Mukesh. *Jour of Mater Chem A*. 5. 3069-3090. 2017

S A Vanalakar, G L Agawane, S W Shin, et al. *Jour of Allo and Comp*, 619. 109-121. 2015

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*Speaker
†Corresponding author: Fanping@szu.edu.cn
‡Corresponding author: linxd@szu.edu.cn