Zinc composition control of $Cu_2ZnSnSe_4$-based thin film solar cells by coevaporation process

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The influence of zinc composition ratio on the properties of co-evaporated $Cu_2ZnSnSe_4$ absorber layers by rapid thermal annealing process has been investigated. It is necessary to control zinc composition ratio in absorber layer that Zn-rich conditions are beneficial because they may improve p-type conductivity and prevent the formation of the ternary Cu_2SnSe_3 compound, even though Zn-excess increases the risk of forming the n-type Zn(S,Se) binary phase. In this study, CZTSe precursors with a various zinc composition ([Zn]/[Sn] = 1.03, 1.06, 1,08, 1.17) were deposited. According to the scanning electron microscope observation, CZTSe absorber layer shows differential grain size and surface morphology related zinc composition ratio. From the results of X-ray diffraction analyses, we determined crystal quality of CZTSe absorber layer by full width at half maximum and texture coefficient. The ZnSe secondary phase is observed in CZTSe absorber layer with zinc-excess sample by Raman spectroscopy. I-V measurement indicates a dependence of different zinc composition ratio in absorber layer. In the optimization of appropriate zinc composition, CZTSe solar cell has obtained with 6.1% conversion efficiency in 0.42cm^2 active area.

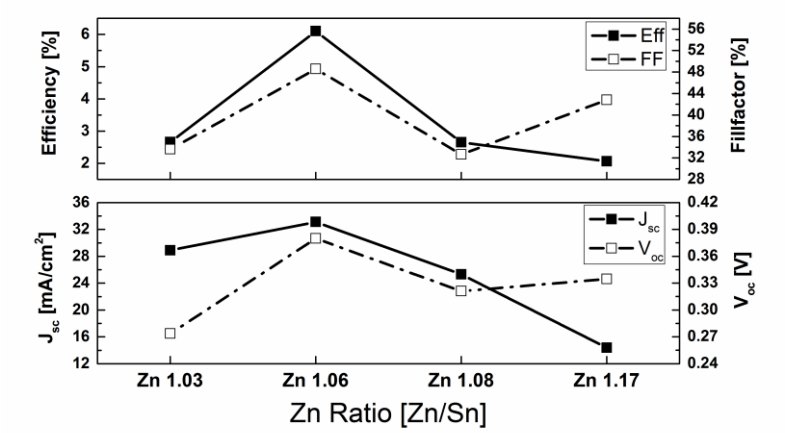

Fig. 1. Device parameters of CZTSe solar cells with various Zn contents by coevaporation process.

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