バイレイヤー法によるCZTSe 太陽電池

Cu₂ZnSnSe₄ thin-film solar cells fabricated using Cu₂SnSe₃/ZnSe bilayers

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Cu₂ZnSn(SₓSe₁₋ₓ)₄ (CZTSSe) compound semiconductor has attracted considerable attention as a more earth abundant, cheaper, and nontoxic alternative to Cu(In,Ga)Se₂ (CIGS) and CdTe. Thus, much effort has been devoted to the fabrication of Cu₂ZnSnSe₄ (CZTSe) thin films by various methods, including vacuum and solution based approaches. In most fabrication methods for CZTSe, pure metals (Cu, Sn, and Zn) and/or binary chalcogenides (CuSe, SnSe, and ZnSe) are used as precursor materials. Theoretical [1] and experimental [2] studies have shown that all the metal precursors react with Se to form binary selenides at approximately 320 °C, and then the ternary Cu₂SnSe₃ (CTSe) phase forms from Cu₂Se and SnSe. Finally, CZTSe forms through the reaction between CTSe and ZnSe. Therefore, the ternary CTSe and the binary ZnSe materials can be used as precursors for the preparation of the CZTSe absorber. This method offers the possibilities of simpler growth and more precise control of CZTSe composition than in the case of using pure metals and binary precursors. We also observed that the grain size of CTSe was larger than that of CZTSe, which were grown under similar growth condition. Thus, it is would be expected that the large grain in CZTSe can be obtained when using the CTSe and ZnSe bilayer as precursors. We have shown that CZTSe thin films was fabricated by using a stacked binary (ZnSe) and ternary (CTSe) compounds precursors, followed by annealing [3]. The CZTSe thin film solar cell using ZnSe and CTSe precursors showed a relatively high efficiency of over 7%, as shown in Fig. 1. This presentation will provide the detailed information about the fabrication method for CZTSe thin film solar cells.

References

Figure 1. J-V characteristics of CZTSe solar cell.