ES-001 <Invited Talk>

Cu2ZnSn(S,Se)4 Thin Film Solar Cells Fabricated by Sulfurization of Stacked Precursors Prepared Using Sputtering Process

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Recently, Cu2ZnSn(S,Se)4 (CZTSS), which is one of the In- and Ga- free absorber materials, has been attracted considerable attention as a new candidate for use as an absorber material in thin film solar cells. The CZTSS-based absorber material has outstanding characteristics such as band gap energy of 1.0 eV to 1.5 eV, high absorption coefficient on the order of 104 cm-1, and high theoretical conversion efficiency of 32.2% in thin film solar cells. Despite these promising characteristics, research into CZTSS based thin film solar cells is still incomprehensive and related reports are quite few compared to those for CIGS thin film solar cells, which show high efficiency of over 20%. I will briefly overview the recent technological development of CZTSS thin film solar cells and then introduce our research results mainly related to sputter based process. CZTSS thin film solar cells are prepared by sulfurization of stacked both metallic and sulfide precursors. Sulfurization process was performed in both furnace annealing system and rapid thermal processing system using S powder as well as 5% diluted H2S gas source at various annealing temperatures ranging from 520°C to 580°C. Structural, optical, microstructural, and electrical properties of absorber layers were characterized using XRD, SEM, TEM, UV-Vis spectroscopy, Hall-measurement, TRPL, etc. The effects of processing parameters, such as composition ratio, sulfurization pressure, and sulfurization temperature on the properties of CZTSS absorber layers will be discussed in detail. CZTSS thin film solar cell fabricated using metallic precursors shows maximum cell efficiency of 6.9% with Jsc of 25.2 mA/cm2, Voc of 469 mV, and fill factor of 59.1% and CZTS thin film solar cell using sulfide precursors shows that of 4.5% with Jsc of 19.8 mA/cm2, Voc of 492 mV, and fill factor of 46.2%. In addition, other research activities in our lab related to the formation of CZTS absorber layers using solution based processes such as electro-deposition, chemical solution deposition, nano-particle formation will be introduced briefly.

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