Optimization of Sb_2S_3 Sensitized Solar Cells by Varying Spinning Cycles of Light Harvesting Material

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Solid state sensitized solar cells have been intensively studied due to their promising cost-effectiveness and stability. Especially, many chalcogenides have been widely investigated as the light absorbing layer in solid-state sensitized solar cells. Among the chalcogenide solar cells, antimony sulfide (Sb_2S_3) is an excellent candidate for light absorption material in solar cells because of its unique characteristics, which are suitable for solar cell applications. Nevertheless, so far, the efficiency of planar configuration Sb_2S_3 solar cells is limited to 7%. However, compared to the higher power conversion efficiencies of the typical chalcogenide solar cells such as cadmium telluride (CdTe) and copper indium gallium selenide (CIGS), there are still many places to improve the Sb_2S_3-based solar cells. In this study, we investigated the performance of Sb_2S_3 solar cells, based on various spin coating cycles (1-4). The Sb_2S_3 precursor solution was prepared by mixing 228 mg of antimony chloride ($SbCl_3$), 114 mg Thiourea and 1.5 ml of 2-methoxyethanol. The prepared solution was spin coated on TiO_2 compact layer at 4000 rpm for 30 s. After spin coating of Sb_2S_3, the film was heated on the hot plate at 150 ^oC for 1 min and followed annealing inside the tube furnace at 280 ^oC for 10 mins under N_2 stream. Then, a P3HT layer was used as a hole transport layer. Finally, 70 nm of thick silver (Ag) layer was deposited by thermal evaporation technique to form the top contact. With the final configuration of FTO/compact TiO_2/Sb_2S_3/P3HT/Ag, a 3.63% power conversion efficiency was reached for two cycles of Sb_2S_3 precursor. The variation of Sb_2S_3 spinning cycles, significantly controls the device performance. UV-Vis absorption, IPCE and EIS spectra were obtained to characterize the devices and they were in a good agreement. Further improvement of the solar cell performance is underway.

Keywords: Sb_2S_3, Solid state solar cell, Spinning cycles, Light harvesting