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Optimization of Sb₂S₃ 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 (Sb₂S₃) 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 Sb₂S₃ 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 Sb₂S₃-based solar cells. In this study, we investigated the performance of Sb₂S₃ solar cells, based on various spin coating cycles (1-4). The Sb₂S₃ precursor solution was prepared by mixing 228 mg of antimony chloride (SbCl₃), 114 mg Thiourea and 1.5 ml of 2-methoxyethanol. The prepared solution was spin coated on TiO₂ compact layer at 4000 rpm for 30 s. After spin coating of Sb₂S₃, the film was heated on the hot plate at 150 °C for 1 min and followed annealing inside the tube furnace at 280 °C for 10 mins under N₂ 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 TiO₂/Sb₂S₃/P3HT/Ag, a 3.63% power conversion efficiency was reached for two cycles of Sb₂S₃ precursor. The variation of Sb₂S₃ 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: Sb₂S₃, Solid state solar cell, Spinning cycles, Light harvesting