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Sputtered Al-Doped ZnO Layers for Cu₂ZnSnS₄ Thin Film Solar Cells

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Al-doped ZnO (AZO) thin films have attracted a lot of attention as a cheap transparent conducting oxide (TCO) material that can replace the expensive Sn-doped In₂O₃. In particular, AZO thin films are widely used as a window layer of chalcogenide-based thin film solar cells such as Cu(In,Ga)Se₂ and Cu₂ZnSnS₄ (CZTS). Mostly important requirements for the window layer material of the thin film solar cells are the high transparency and the low sheet resistance, because they influence the light absorption by the active layer and the electron collection from the active layer, respectively. In this study, we prepared the AZO thin films by RF magnetron sputtering using a ZnO/Al₂O₃ (98 : 2wt%) ceramic target, and the effect of the sputtering condition such as the working pressure, RF power, and the working distance on the optical, electrical, and crystallographic properties of the AZO thin films was investigated. The AZO thin films with optimized properties were used as a window layer of CZTS thin film solar cells. The CZTS active layers were prepared by the electrochemical deposition and the subsequent sulfurization process, which is also one of the cost-effective synthetic approaches. In addition, the solar cell properties of the CZTS thin film solar cells, such as the photocurrent density-voltage (J-V) characteristics and the external quantum efficiency (EQE) were investigated.

Keywords: Al-doped ZnO (AZO), Cu₂ZnSnS₄ (CZTS), Thin film solar cells