

Effect of Complex Agent NH_3 Concentration on the Chemically Deposited Zn Compound Thin Film on the $\text{Cu}(\text{In,Ga})\text{Se}_2$

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The $\text{Cu}(\text{In,Ga})\text{Se}_2$ (CIGS) thin film solar cells have been achieved until almost 20% efficiency by NREL. These solar cells include chemically deposited CdS as buffer layer between CIGS absorber layer and ZnO window layer. Although CIGS solar cells with CdS buffer layer show excellent performance, many groups made hard efforts to overcome its disadvantages in terms of high absorption of short wavelength, Cd hazardous element. Among Cd-free candidate materials, the CIGS thin film solar cells with Zn compound buffer layer seem to be promising with 15.2%(module by showa shell K.K.), 18.6%(small area by NREL). However, few groups were successful to report high-efficiency CIGS solar cells with Zn compound buffer layer, compared to be known how to fabricate these solar cells. Each group's chemical bath deposition (CBD) condition is seriously different. It may mean that it is not fully understood to grow high quality Zn compound thin film on the CIGS using CBD. In this study, we focused to clarify growth mechanism of chemically deposited Zn compound thin film on the CIGS, especially. Additionally, we tried to characterize junction properties with unfavorable issues, that is, slow growth rate, imperfect film coverage and minimize these issues.

Early works reported that film deposition rate increased with reagent concentration and film covered whole rough CIGS surface. But they did not mention well how film growth of zinc compound evolves homogeneously or heterogeneously and what kinds of defects exist within film that can cause low solar performance. We observed sufficient correlation between growth quality and concentration of NH_3 as complex agent. When NH_3 concentration increased, thickness of zinc compound increased with dominant heterogeneous growth for high quality film. But the large amounts of NH_3 in the solution made many particles of zinc hydroxide due to hydroxide ions. The zinc hydroxides bonded weakly to the CIGS surface have been removed at rinsing after CBD.

Keywords: CIGS Solar Cell, Chemical Bath Deposition, ZnS, NH_3 Complex agent

Cd 수용액 처리 조건에 따른 $\text{Cu}(\text{In,Ga})\text{Se}_2$ 태양전지의 성능변화

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최근 $\text{Cu}(\text{In,Ga})\text{Se}_2$ (CIGS)와 같은 박막 태양전지에 대한 연구가 많은 관심을 끌고 있다. CIGS 태양전지의 광투과층으로 사용되고 있는 II-VI족 화합물 반도체인 CdS는 상온에서의 에너지 밴드 갭(band gap)이 2.42eV 정도로서, 가시광 영역의 많은 빛을 투과시키고, 적절한 제작 조건하에서 비교적 낮은 비저항을 나타내기 때문에 널리 사용되고 있다. 하지만 CIGS 태양전지 연구는 주로 CIGS 흡수층 제조공정에 편중되어 있으며, CdS 버퍼층 공정조건에 대한 체계적인 연구가 부족하다고 판단된다. 습식공정인 Chemical Bath Deposition (CBD)에 의해 주로 제조되는 CdS는 단순한 제조공정에도 불구하고 CIGS 태양전지의 성능에 지대한 영향을 미치는 것으로 알려져 있다. 특히, CdS합성반응이 개시되기 전까지의 용액잔류시간 (dip time)은 CIGS내로의 Cd이온 농도를 결정하는 중요한 공정변수로 판단된다. CIGS 표면에 Cd이 도핑될 경우, CIGS는 n형 전도성을 갖는 얇은 층을 갖게 되어 전체적으로 n-CIGS/p-CIGS의 동종 접합을 형성하는 장점을 부여할 것으로 기대된다. 따라서 본 논문에서는 dip time을 주요변수로 하여 CIGS 태양전지의 성능에 미치는 영향을 주로 고찰하였다. Cd의 확산 정도는 secondary ion mass spectroscopy (SIMS)를 이용하여 정량화하였으며, 제조된 CIGS 태양전지의 전류-전압 특성과 상관성을 제시하고자 한다.

Keywords: CIGS Solar Cell, Chemical Bath Deposition, CdS