Cd-free 태양전지를 위한 ZnS/CIGS 이종접합 특성 향상 연구

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Study of ZnS/CIGS Hetero-interface for Cd-free CIGS Solar Cells

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The Cu(In,Ga)Se2 (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, the short wavelength response of CIGS solar cell is limited by narrow CdS band gap of about 2.42 eV. Taking into consideration the environmental aspect, the toxic Cd element should be replaced by a different material. Among Cd-free candidate materials, the CIGS thin film solar cells with ZnS buffer layer seem to be promising with 17.2%(module by showa shell K.K.), 18.6%(small area by NREL). However, ZnS/CIGS solar cells still show lower performance than CdS/CIGS solar cells. There are several reported reasons to reduce the efficiency of ZnS/CIGS solar cells. Nakada reported ZnS thin film had many defects such as stacking faults, pin-holes, so that crytallinity of ZnS thin film is poor, compared to CdS thin film. Additionally, it was known that the hetero-interface between ZnS and CIGS layer made unfavorable band alignment. The unfavorable band alignment hinders electron transport at the heteo-interface.

In this study, we focused on growing defect-free ZnS thin film and for favorable band alignment of ZnS/CIGS, bandgap of ZnS and CIGS, valece band structure of ZnS/CIGS were modified. Finally, we verified the photovoltaic properties of ZnS/CIGS solar cells.

Key words : ZnS(황화아연), Buffer layer(버퍼층), Chemical bath deposition(용액성장법), CIGS solar cell(CIGS 태양전지)

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CdTe 태양전지 제조 공정에 따라 변화하는 CdS 와 CdTe 박막의 물성 변화 분석

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The Analysis of CdS and CdTe Thin Film at the Processes of Manufacturing CdTe Solar Cells

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다층 박막 구조로 이루어진 CdS/CdTe 태양전지의 경우, 각각의 박막이 다양한 제조 공정을 거치면서 물성특성의 변화를 겪게 된다. 각각의 박막이 고온의 열처리 공정과, $CdCl_2$ 용액 처리 및 후면 산화막 제거 공정 등을 거치게 되면서 겪게 되는 물성 변화 분석을 살펴보고자 한다.

각각의 박막 제조 방식은 일반적으로 사용되는 방식으로, CdS의 경우는 용액성장법(Chemical Bath Deposition, CBD), CdTe의 경우는 근접승화법(Closed Space Sublimaition, CSS)을 사용했으며, X-Ray Diffractometer (XRD), Raman spectroscopy, Field Emission Scanning Electron Microscope (FE-SEM), Energy Dispersive Spectroscopy (EDS), X-ray Photoelectron Spectroscopy (XPS) 등을 이용하여 분석하였다.

각각의 셀 제조 공정을 거치면서 CdS, CdTe 박막들은 결정, 광 특성, 성분 변화를 보였다.

Key words : manufacturing process(제조공정), CdS/CdTe solar cells(CdS/CdTe 태양전지), analysis(분석), CSS(근접승화법), CBD(용액성장법), CdCl2 treatment(CdCl2 처리)

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