COMPARATIVE STUDY OF HEAT LIGHT SOAKING ON MF (M= K, Cs) TREATED CIGS SOLAR CELLS WITH CDS BUFFER LAYER

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Introduction: Alkali metals such as sodium (Na), potassium (K), rubidium (Rb), and caesium (Cs) deposition after Cu(In,Ga)Se₂ (CIGS) growth is a noble approach to achieve high-conversion-efficiency CIGS solar cells. Some facts are already known, but there are still a lot of properties to be revealed. With this motivation, we investigated the effect of light soaking (LS), heat soaking (HS), and heat-light soaking (HLS) on MF (M = K, Cs) treated CIGS solar cells with CdS buffer layer.

Experimental: CIGS thin films with a thickness of 2.5-3.0 μm-thick were deposited through a three-stage process using a molecular beam epitaxy system at a maximum substrate temperature of 530 °C. KF- and CsF-PDT were performed on air-exposed CIGS thin film at a substrate temperature of 350 °C. Before CdS deposition, these CIGS thin films were rinsed in deionized water. CIGS solar cells were fabricated with MgF₂ (105 nm)/Al/Ni/ZnO:Al (300 nm)/ZnO (100 nm)/CdS (60 nm)/ CIGS (2.5-3.0 μm)/Mo (600 nm)/SLG structure. LS was performed under one sun illumination using a solar simulator. HS was performed at 130 °C. HLS was performed under one sun illumination at 130 °C.

Result and discussion: LS and HS did not significantly change the initial cell performance for both alkali untreated and MF (M = K, Cs) treated CIGS solar cells. In contrast, the combined LS and HS, that is, HLS showed positive effect, which increased open circuit voltage (Vₜₜ), fill factor (FF), and their cell efficiencies. However, such a desirable improvement was not observed for alkali-untreated CIGS solar cells. The short circuit current density (Jₜₜ) reduced after HLS for both alkali-untreated and treated CIGS solar cell. Capacitance-voltage measurement confirmed significant increased carrier concentration after HLS. Very interesting observation after HLS was that the larger the atomic radius of alkali metal, the higher the increased carrier concentration as shown in Figure 1. Therefore, the effect of HLS was found much more effective on CsF-treated CIGS solar cells than that of KF-treated solar cells. The detail results including J-V, EQE, C-V, EBIC, XPS and J-V-T will be presented.

Figure 1. Capacitance-voltage (C-V) measurements of MF (M = K, Cs) treated CIGS solar cells before and after HLS under identical conditions. The net doping concentration and space charge region (SCR) were determined at V = 0V, which are marked by black dots.

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