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Effect of Ga Profile in Cu(InGa)Se_2 Prepared by Multi-Layer Precursor Method on Cell Performance

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Calcopyrite Cu(InGa)Se_2 (CIGS) is one of the most promising materials to fabricate low-cost and high-efficiency thin film solar cells. It is known that Ga profile, Ga/(In+Ga), in CIGS plays vital role in high photovoltaic performance[1]. CIGS on soda-lime glass (SLG)/Mo was deposited by multi-layer precursor method. In the process, Ga-Se/In-Se/Cu-Se precursors were prepared at substrate temperature of 300 ^{o}C, and then annealed in Se flux at substrate temperature of 580 ^{o}C. Next, the samples were capped by the co-evaporation of In, Ga, and Se at the same temperature, and subsequently cooled in Se flux down to 470 ^{o}C. In this work, to optimize the Ga-grading profile, Ga flux investigated by beam flux monitor during CIGS film deposition was primarily manipulated for improvement of cell performance.

Figure 1 shows Ga profiles in CIGS fabricated under constant Ga flux and controlled Ga flux during the film deposition. In the figure, the double Ga-grading profile was achieved in the case of controlled Ga flux, which is a good trend for high cell performance. Figure 2 depicts photo J-V characteristics of CIGS solar cells with CIGS deposited under constant Ga flux and controlled Ga flux. It is seen that the cell performance can be enhanced up to 15.30 % without anti-reflective layer in the case of controlled Ga flux due to double Ga-grading profile in CIGS. The results suggest that double Ga-grading profile successfully controlled by Ga flux during CIGS deposition is an important parameter for high cell efficiency.

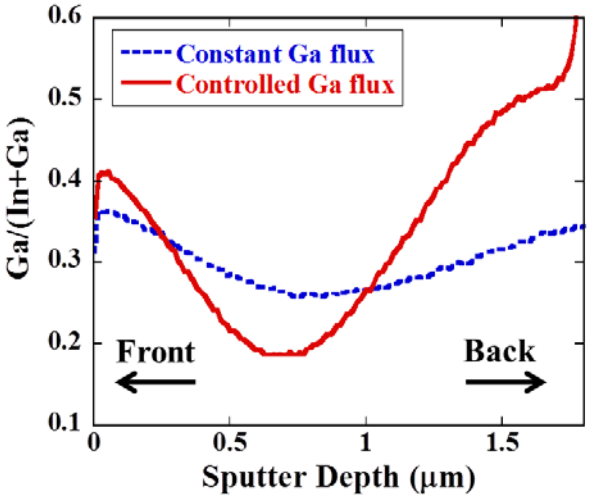

Figure 1. Ga profiles in CIGS prepared under constant Ga flux and controlled Ga flux during CIGS deposition.

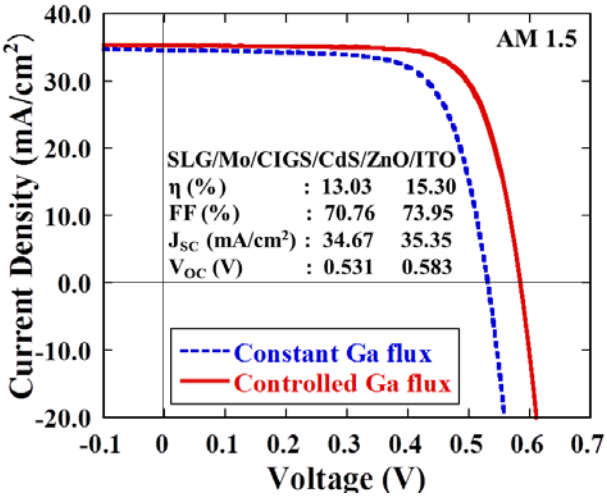

Figure 2. Photo J-V characteristics of CIGS solar cells, SLG/Mo/CIGS/CdS/ZnO/ITO, with CIGS deposited under constant Ga flux and controlled Ga flux.

Reference

[1] Adrian Chirila et al., Nature Materials **10** (2011) 857.

Acknowledgement

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