Submicron CIGS based solar cells with $AgGaS_2$ interlayer for Building-integrated photovoltaic application

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Building integrated photovoltaic (BIPV) can help in the efficient utilization of daylight in the buildings along with the conversion of sunlight to electricity. The energy saving can reach ~50%, which mainly depends on transparency, orientation, window to wall ratio, and climate conditions. See through CIGS solar cell has advantages of higher power conversion efficiency and long life time as compare to dye sensitized solar cells, which experience long-term durability issues due to presence of liquid electrolyte in them.

In our work, solar cells made from CIGS thin film (~300 nm) deposited on ITO glass showed conversion efficiency of ~3.8% with transparency around 20%. But CIGS solar cells prepared on ITO suffer from inferior uniformity in performance. For the sake of improving this uniformity and reducing the back surface recombination, which is highly desired in ultra thin film solar cells, $AgGaS_2$ (AGS)(Eg ~2.60 eV) layer was introduced between ITO and CIGS (Eg ~1.50 eV). Optimization of AGS thickness w.r.t CIGS layer was performed and it was found that AGS with thickness of ~20% of CIGS thickness was optimal. CIGS based solar cells with AGS interlayer exhibited superior inter-cells uniformity in term of performance. Cell with total thickness of 300 nm (CIGS+AGS) exhibited 5.8 % conversion efficiency with 25% transparency. This implies that AGS interlayer can improve the power conversion efficiency in the ultra thin CIGS solar cells. When we extended this proposition to slight thick CIGS, efficiency first slightly increased due to increase in Jsc by ~4 mA/cm^2 but on further increasing the thickness, efficiency reduced due to large decrease in fill factor (FF) rather the fact that Jsc increased by ~3 mA/cm^2. This intimates that higher thickness of AGS offer higher resistance to the collection of holes at the back contact. The detailed exploration of decrease in the FF is in process.