Industrially viable nanofabrication and simulation to boost ultrathin and bifacial CIGS solar cells

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Nanotechnologies

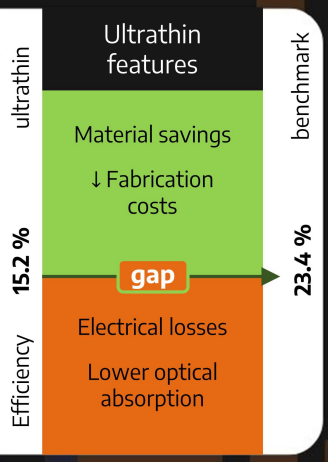
Motivation

Problem:

- Energy crisis
- Pollutant energy sources

One solution:

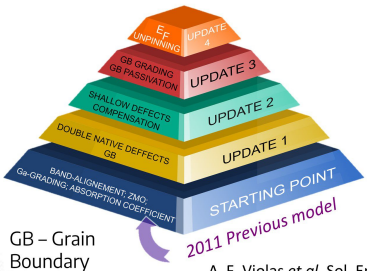
- Photovoltaic energy
- $Cu(In,Ga)Se_2$ (CIGS) thin-film solar cell
- Ultrathin devices



Work performed: Simulation & Experimental

Simulation (SCAPS)

- CIGS layer updates



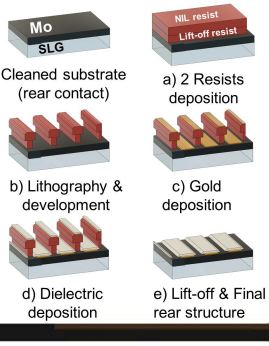
GB – Grain Boundary

≥ 21.0 %
ultrathin CIGS

Incorporate at rear contact:

- Dielectric (tackle electrical losses)
- Reflector (tackle optical losses)

Experimental steps



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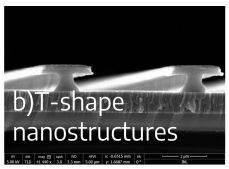
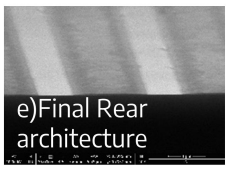
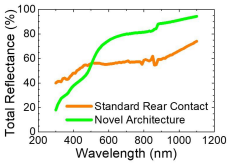
Nanofabrication

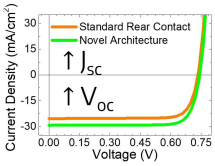




- Optimized Nanoimprint lithography and development conditions
- Final architecture with a metal reflector and a passivating dielectric

Impact





Increased Rear Reflection

Better electrical + optical cell performance

(simulated)

Summary & Future Work

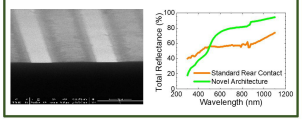
Shrink the ultrathin *vs* benchmark gap.

Updated SCAPS model suggested:

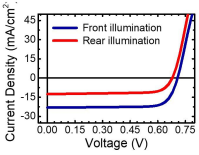
reflector + dielectric

at the rear contact.

Experimental fabricated structure



Bifacial cell



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