Ming Hsieh Department of Electrical Engineering

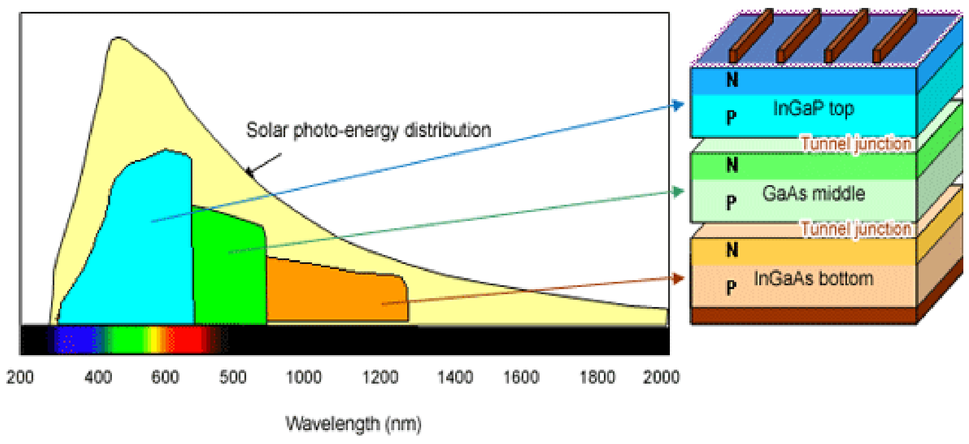
USC Viterbi School of Engineering

High Efficiency Solar Spectrum Dispersion: Using Multilayer Nanostructures for Energy Harvesting

Yuhan Yao, He Liu
Wei Wu Group, Department of Electrophysics

Introduction

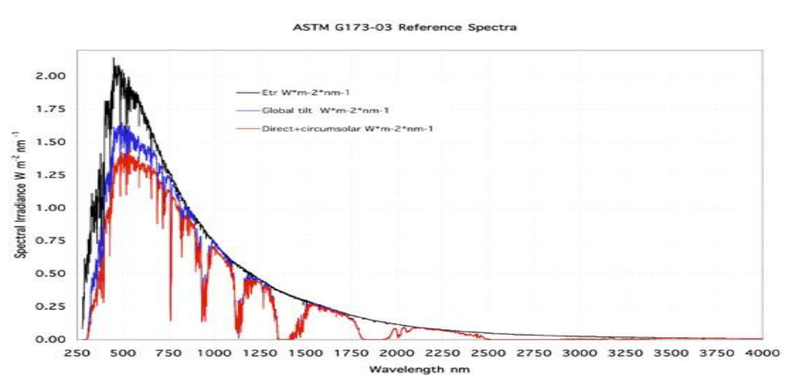
For higher efficiency, solar cells with multiple vertically-stacked junctions are often used.

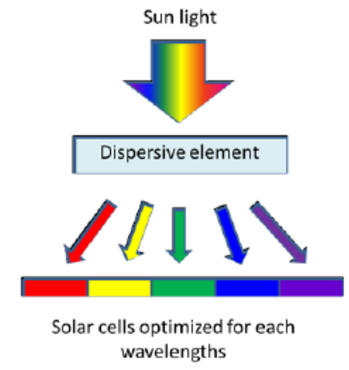


Lattice matching
Current matching
Transparency
Serial Resistance

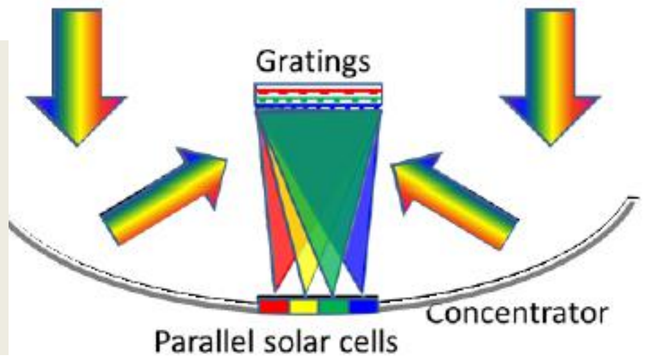
Limit

45.5% reported (68% is theoretical limit)



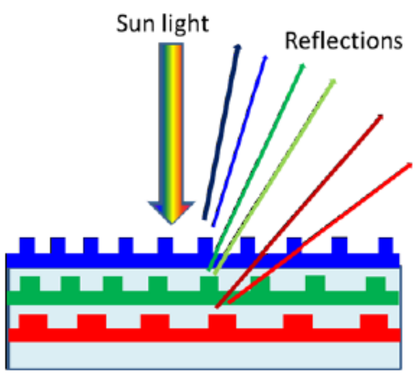


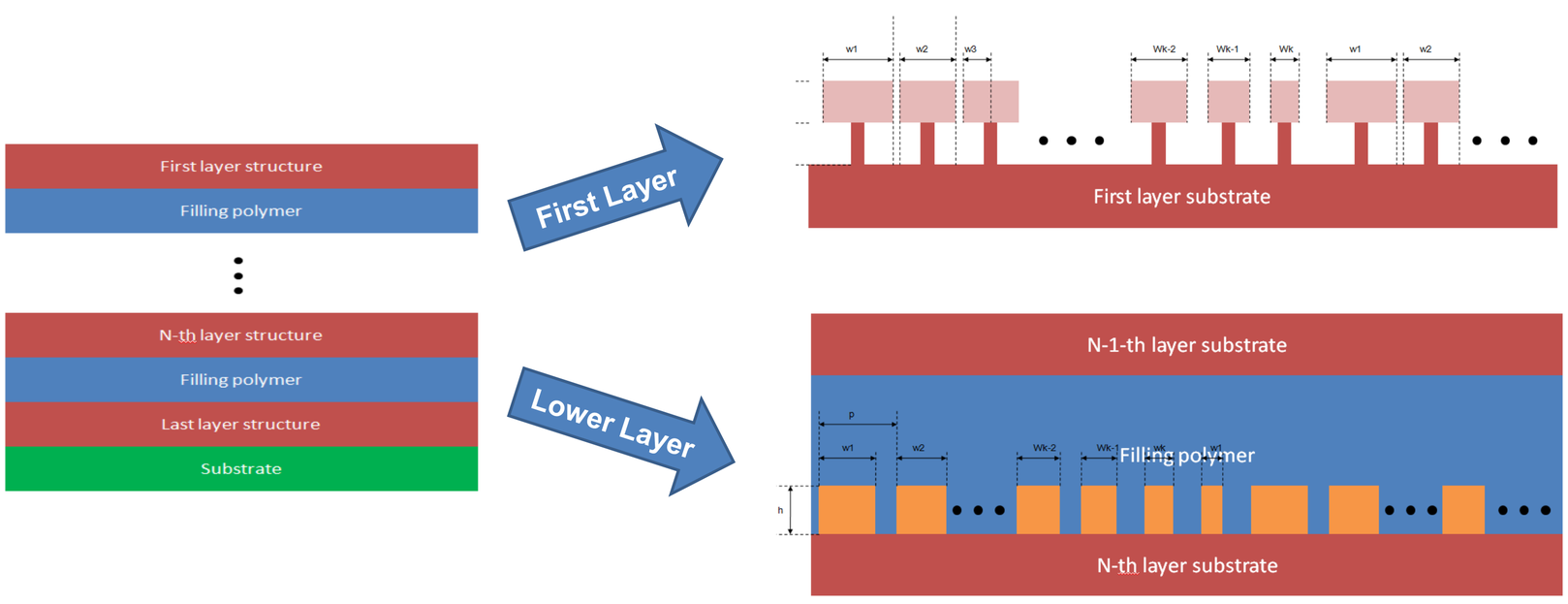
We reveal a strategy to develop a novel photovoltaic system by integrating planar dispersive elements with solar cells sensitive to different spectrum ranges arranged in parallel



Structure Design

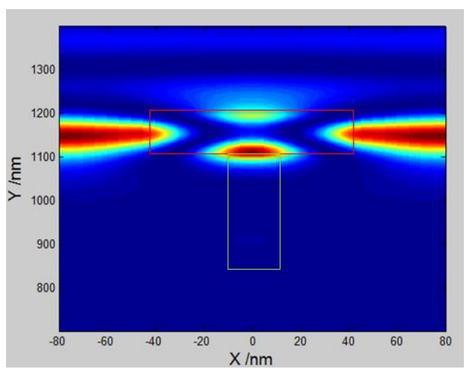
Our novel arrangement is enabled by dispersive mirrors that reflect different frequency components of the solar spectrum to corresponding cells that are specifically optimized for each respective spectral range.

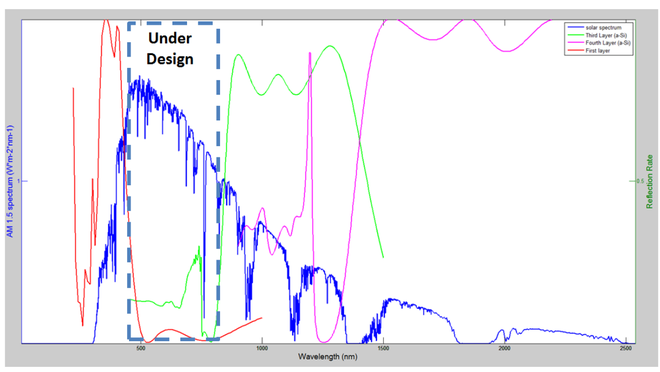


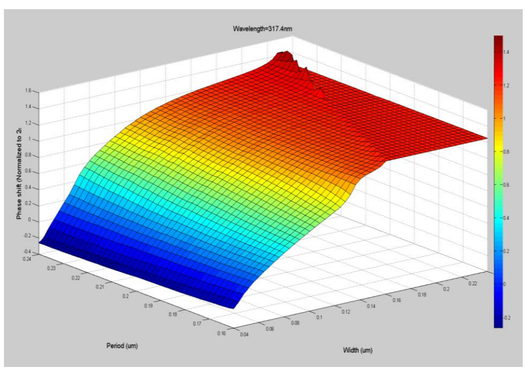


Proof-of-principle Simulation

Our numerical work shows that the dispersive mirror can direct light of different wavelengths into different angles for the entire solar spectrum, maintaining very low power loss.

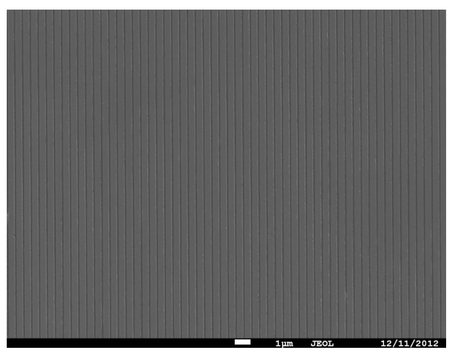


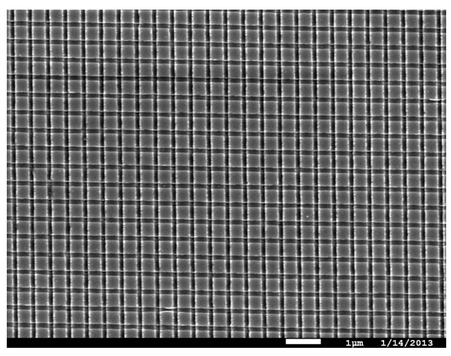




Fabrication & Future work

All of our designs have planar geometry, so they can be mass-produced by nanoimprint lithography (NIL). We are trying 1D/2D grating NIL fabrication. Some of our recent results are shown here.





In the future, we will do electron beam writing and fabricate multiplayer structures. Experimental tests will be done.

Contact information: yuhanyao@usc.edu

Ming Hsieh Institute
Ming Hsieh Department of Electrical Engineering