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Scaling effects in solar cells: the path to grid parity

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ABSTRACT:

If solar energy is ever going to become a mainstream power source, the technologies for harnessing sunlight have to become cheaper than all other forms of energy, be easy and quick to install, and work more safely, reliably and durably than present-day grid power. Our research team is striving to make this happen by utilizing microdesign and microfabrication techniques used in the semiconductor, LCD and microsystem industries. In this talk, I would describe microsystems-enabled photovoltaic (MEPV) concepts that consist of the fabrication of micro-scale crystalline CdTe, silicon, and GaAs solar cells.

For the CdTe solar cells, interesting nanostructures have promising scaling benefits to make CdTe (currently the cheapest PV technology) pass the 16% efficiency barrier for which it has been stagnant for the last 16 years. For the case of GaAs and Silicon, we have created a release process of these cells into a proposed photovoltaic (PV) “ink” solution, and the printing of these cells onto a substrate using fluidic self-assembly approaches.

So far, we have produced 10 percent efficient crystalline back contacted GaAs cells that are 3 µm thick and 14.9 percent efficient crystalline silicon cells that are 14 µm thick. The costs associated with this module assembly approach in conjunction with optical concentration can be well below $1/Wattpeak while retaining the superior conversion efficiency and durability.

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