Docket #: S12-012

Nanostructured material for high efficiency single junction solar cells

Stanford engineers have developed and tested a nanostructured thin film material that upconverts infrared to visible light and combines electrical and non-linear optical properties in the same layer. This material is fabricated with nanoparticles using a low cost, scalable deposition process. The resulting film conducts current with a sheet resistance comparable to state-of-the-art transparent conductive oxides. Upconverted emission is enhanced 4.1 -4.7 X relative to known materials, with high potential for further optimization. In addition to solar cells (both photovoltaic and photoelectrochemical), this technology has applications in bioimaging, security and encoding.

Stage of Research:
For photovoltaics, the inventors have calculated that upconversion can increase cell efficiency by 44%, and that it can increase the efficiency of any single junction solar cell.

Applications

- **Solar cells:**
  - back contact for photovoltaics
  - electrical contact in photoelectrochemical cells
- **Bioimaging** - may allow for spatially resolved electrical measurements and imaging dynamic biological processes
- **Security and encoding** - invisible nano-ink for combating counterfeiting and electrical conductivity provides novel interface with chip-based identification features

Advantages

- **Low cost structure** - architecture combines electrical and optical properties in the same layer to reduce material costs
- **High efficiency power conversion** - models indicate that upconversion can increase cell efficiency by 44%
- **Highly scalable fabrication** - deposition process for nanoparticles is compatible with roll-to-roll processing

Publications

- Stanford paper from GCEP Annual Report. “Upconverting Electrodes for Improved Solar Energy Conversion.” April 22, 2012.
- Poster presented at 2011 GCEP Annual Symposium. "Plasmonic upconversion for photovoltaics." October 10, 2012.

Patents

- Published Application: 20130276877

Innovators

- Diane Wu
- Jennifer Dionne
- Alberto Salleo

Licensing Contact

Evan Elder

Associate Director, Licensing and Strategic Alliances, Physica

Email