# Breakthrough promises significantly more efficient solar cells

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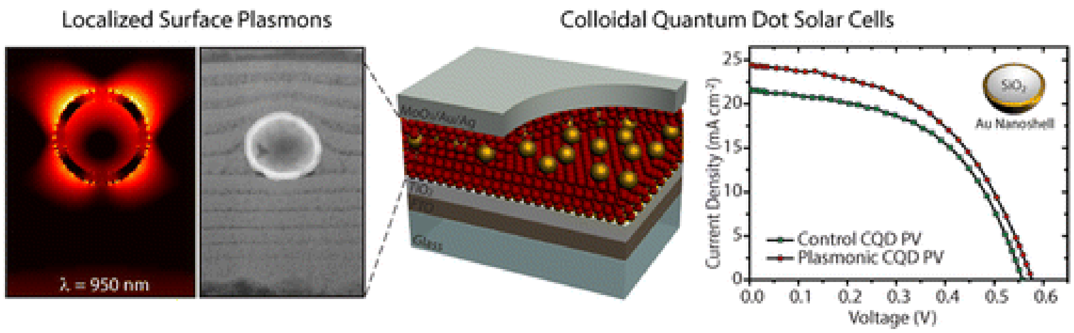


A new technique developed by U of T Engineering Professor Ted Sargent and his research group could lead to significantly more efficient solar cells, according to a recent paper published in the journal *Nano Letters*.

The paper, "Jointly-tuned plasmonic-excitonic photovoltaics using nanoshells," describes a new technique to improve efficiency in colloidal quantum dot photovoltaics, a technology which already promises inexpensive, more efficient solar cell technology. Quantum dot photovoltaics offers the potential for low-cost, large-area solar power – however these devices are not yet highly efficient in the infrared portion of the sun's spectrum, which is responsible for half of the sun's power that reaches the Earth.

The solution? Spectrally tuned, solution-processed plasmonic nanoparticles. These particles, the researchers say, provide unprecedented control over light's propagation and absorption.

The new technique developed by Sargent's group shows a possible 35 per cent increase in the technology's efficiency in the near-infrared spectral region, says co-author Dr. Susanna Thon. Overall, this could translate to an 11 per cent solar power conversion efficiency increase, she says, making quantum dot photovoltaics even more attractive as an alternative to current solar cell technologies.

"There are two advantages to colloidal quantum dots," Thon says. "First, they're much cheaper, so they reduce the cost of electricity generation measured in cost per watt of power. But the main advantage is that by simply changing the size of the quantum dot, you can change its light-absorption spectrum. Changing the size is very easy, and this size-tunability is a property shared by plasmonic materials: by changing the size of the plasmonic particles, we were able to overlap the absorption and scattering spectra of these two key classes of nanomaterials."

Sargent's group achieved the increased efficiency by embedding gold nanoshells directly into the quantum dot absorber film. Though gold is not usually thought of as an economical material, other, lower-cost metals can be used to implement the same concept proved by Thon and her co-workers.

She says the current research provides a proof of principle. "People have tried to do similar work but the problem has always been that the metal they use also absorbs some light and doesn't contribute to the photocurrent - so it's just lost light."

More work needs to be done, she adds. "We want to achieve more optimization, and we're also interested in looking at cheaper metals to build a better cell. We'd also like to better target where photons are absorbed in the cell – this is important photovoltaics because you want to absorb as many photons as you can as close to the charge collecting electrode as you possibly can."

The research is also important because it shows the potential of tuning nanomaterial properties to achieve a certain goal, says Paul Weiss, Director of the California NanoSystems Institute at the University of California, Los Angeles (UCLA).

"This work is a great example of fulfilling the promise of nanoscience and nanotechnology," Weiss says. "By developing the means to tune the properties of nanomaterials, Sargent and his co-workers have been able to make significant improvements in an important device function, namely capturing a broader range of the solar spectrum more effectively."

**More information:** pubs.acs.org/doi/abs/10.1021/nl304604y

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