Silicon nanoparticles enhance performance of solar cells

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Placing a film of silicon nanoparticles onto a silicon solar cell can boost power, reduce heat and prolong the cell's life, researchers now report.

"Integrating a high-quality film of silicon nanoparticles 1 nanometer in size directly onto silicon solar cells improves power performance by 60 percent in the ultraviolet range of the spectrum," said Munir Nayfeh, a physicist at the University of Illinois and corresponding author of a paper accepted for publication in *Applied Physics Letters*.

A 10 percent improvement in the visible range of the spectrum can be achieved by using nanoparticles 2.85 nanometers in size, said Nayfeh, who also is a researcher at the university's Beckman Institute.

In conventional solar cells, ultraviolet light is either filtered out or absorbed by the silicon and converted into potentially damaging heat, not electricity. In previous work, however, Nayfeh showed that ultraviolet light could efficiently couple to correctly sized nanoparticles and produce electricity. That work was reported in the August 2004 issue of the journal Photonics Technology Letters.

To make their improved solar cells, the researchers began by first converting bulk silicon into discrete, nano-sized particles using a patented process they developed. Depending on their size, the nanoparticles will fluoresce in distinct colors.

Nanoparticles of the desired size were then dispersed in isopropyl

alcohol and dispensed onto the face of the solar cell. As the alcohol evaporated, a film of closely packed nanoparticles was left firmly fastened to the solar cell.

Solar cells coated with a film of 1 nanometer, blue luminescent particles showed a power enhancement of about 60 percent in the ultraviolet range of the spectrum, but less than 3 percent in the visible range, the researchers report.

Solar cells coated with 2.85 nanometer, red particles showed an enhancement of about 67 percent in the ultraviolet range, and about 10 percent in the visible.

The improved performance is a result of enhanced voltage rather than current, Nayfeh said. “Our results point to a significant role for charge transport across the film and rectification at the nanoparticle interface.”

The process of coating solar cells with silicon nanoparticles could be easily incorporated into the manufacturing process with little additional cost, Nayfeh said.

Source: University of Illinois at Urbana-Champaign