Singapore researchers develop cheaper yet efficient thin film solar cells

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Researchers in Singapore have exploited advanced nanostructure technology to make a highly efficient and yet cheaper silicon solar cell. With this development, the researchers hope that the cost of solar energy can be halved.

Developed jointly by Nanyang Technological University (NTU) and A*STAR Institute of Microelectronics (IME), the new thin-film silicon solar cells are designed to be made from cheaper, low grade silicon. However it is able to generate electricity currents close to that produced by traditional solar cells made from costly, high quality silicon.

The new NTU-A*STAR nano-structured solar cells can produce a current of (34.3mA/cm^2) – a world record for a silicon solar cell of its kind.

This is made possible by creating a unique texture using nanostructures – which is thousands of times smaller than human hair – on the surface of the solar cell.

The resulting electricity current output is close to those of traditional cells (40mA/cm^2). Conventional thin film solar cells usually produce about half of the current that traditional cells produce.

Adoption of solar energy around the world is hindered by the high cost of traditional solar panels, partially due to it being made from high grade crystalline bulk silicon.

Using low-grade amorphous (shapeless) silicon thin film that has no texture – which is over 100 times thinner – addresses the material cost issue, but it is not as effective in converting sunlight to electricity, thus producing less energy.

The newly developed nanostructure method, which creates a unique texture on the surface of amorphous silicon, improves the Power Conversion Efficiency (PCE) of the thin film silicon cell and so increases the energy output.

The lead of the project from IME, Dr Navab Singh, Senior Scientist of IME's NanoElectronics Programme, said: "To mitigate against reduced light absorption and carrier recombination in the amorphous silicon thin film cells, we designed and fabricated the novel nanostructures on silicon surface. The sole application of IME's surface texturing strategy achieved a record high of short circuit current density with 5.26% PCE."

"The cell level power conversion efficiencies of bulk crystalline Si solar cells are 20 – 25%. Given that short circuit current density is directly proportional to PCE, it is conceivable that subsequent efforts to improve fill factor and open circuit voltage would boost the final PCE of the silicon thin film solar cells greatly to match that of bulk Si solar cells. Our future research efforts will explore additional light trapping strategies such as plasmonics," continued Dr Singh.

Professor Cheng Tee Hiang, Chair of the School of Electrical and Electronic Engineering, said improving the efficiency of low-cost solar cells is critical in encouraging adoption of solar energy around the world.

"Today's world is faced with several challenges, which include the depletion of fossil fuels, increased cost of such fuels and a growing carbon footprint. At NTU, we are committed to develop the next generation of solar cells which are cheap, efficient and easy to

manufacture, so as to enable solar energy to play a bigger role as a renewable resource."

Sustainability is one of NTU's Five Peaks of Excellence which the university aims to make its mark globally under NTU 2015 five year strategic plan. The other four peaks include future healthcare, new media, the best of the East and West, and innovation.

Professor Dim-Lee Kwong, Executive Director of IME, said, "The demand for thin film solar cells are expected to double by 2013. IME's research efforts in this area are congruent with the world-wide movement towards renewable pro-environment and cost-viable energy solutions."

Provided by Nanyang Technological University