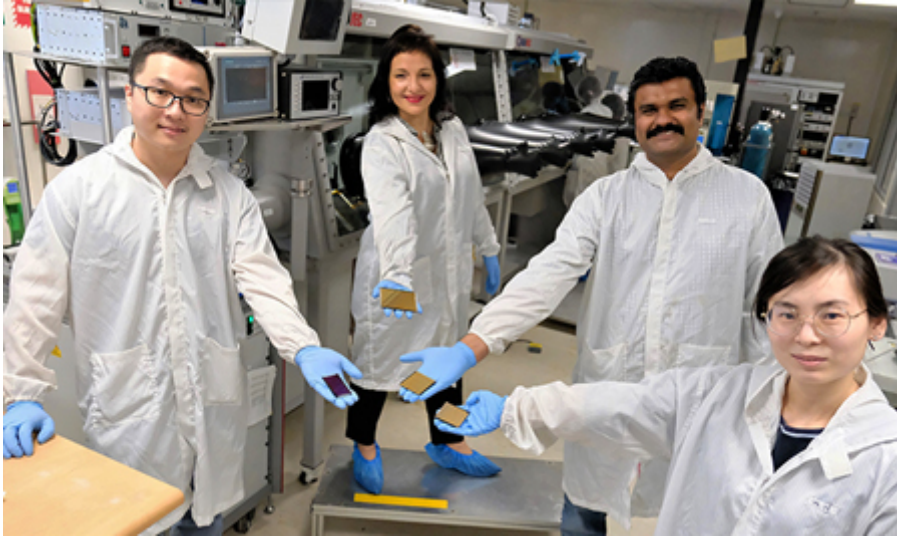


Scaled-up perovskite solar cells exceed highest recorded power conversion

14 Jul 2020

Developed by NTU Singapore scientists using existing industry method, the achievement "takes perovskites a step closer to market."

A team of researchers at **Nanyang Technological University, Singapore** has created a perovskite solar mini module, which they claim has the highest power conversion efficiency of any perovskite-based device larger than 10 cm².



Team effort: perovskites can create flexible and semi-transparent solar cells.

The NTU researchers report that they have adopted a common industrial coating technique called "thermal co-evaporation" and found that it can fabricate solar cell modules of 21 cm² size with record power conversion efficiencies of 18.1 per cent; these are the highest recorded values reported thus far for scalable perovskite solar cells, say the team.

Thermal evaporation is an established coating technique currently used to produce optoelectronics devices such as organic light emitting diode (OLED)-based TV screens.

Spin coating

Dr Annalisa Bruno, Senior Scientist at the Energy Research Institute @ NTU (ERI@N) explained the roadblock in the large-scale adoption of perovskite solar modules. "The best-performing perovskite solar cells have so far been realized in the laboratory at sizes much smaller than 1 cm², using a solution-based technique, called spin-coating. However, when used on a large surface, the method results in perovskite solar cells with lower power conversion efficiencies. This is due to the intrinsic limitations that include defects and lack of uniformity over large areas, making it challenging for industrial fabrication methods," she said.

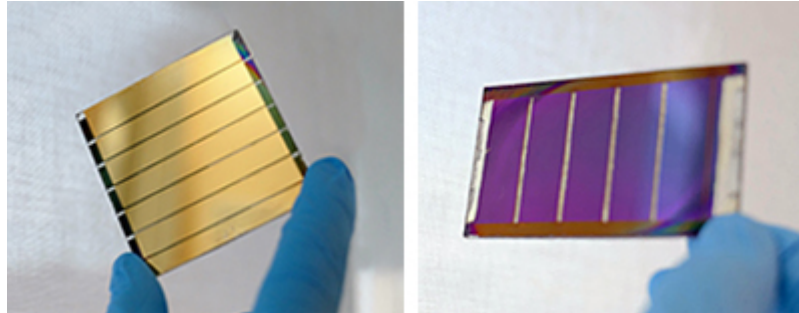
"By using thermal evaporation to form the perovskite layer, our team successfully developed perovskite solar cells with the highest recorded power conversion efficiency reported for modules larger than 10 cm².

"Our work demonstrates the compatibility of perovskite technology with industrial processes, and its potential for market entry. This is good news for Singapore, which is looking to ramp up the use of solar energy for its power needs."

Research fellow at ERI@N, Dr Li Jia said, "We have demonstrated the excellent scalability of co-evaporated perovskite solar cells for the first time. This step will accelerate the transition of this technology from laboratory to industry."

More surface area with colored perovskite cells

Utilizing the same technique, the researchers then fabricated coloured semi-transparent versions of the perovskite solar cells and mini modules, which achieved similar measures of power conversion efficiency across a whole range of different colours.



Colored semi-transparent versions of a perovskite solar mini module.

These results demonstrate the versatility of the thermal evaporation method in producing a variety of perovskite-based solar devices for a variety of optoelectronic applications.

NTU Associate Vice President (Strategy & Partnerships), Professor Subodh Mhaisalkar, who is also Executive Director of the Energy Research Institute @ NTU, said the findings open doors for Singapore and urban environments in other countries to harness the power of sunlight more efficiently than ever before.

"The solar mini modules can be used on facades and windows in skyscrapers, which is not possible with current silicon solar panels as they are opaque and block light. Building owners will be able to incorporate semi-transparent colored solar cells in the architectural designs to harvest even more solar energy without compromising the aesthetic qualities of their buildings."

Professor Armin Aberle, CEO of the Solar Energy Research Institute of Singapore at the National University of Singapore said, "This work represents the first demonstration of highly efficient large-area perovskite solar cells fabricated by an industrially compatible process. We are working closely with NTU in the future development of 30% efficient perovskite-on-silicon tandem solar cells in Singapore."

The NTU team is now looking at integrating perovskite and silicon solar cells to create a tandem solar cell. Such a configuration fabricated using cost-effective and scalable processes can substantially increase the solar electricity production per unit area while keeping production costs low.