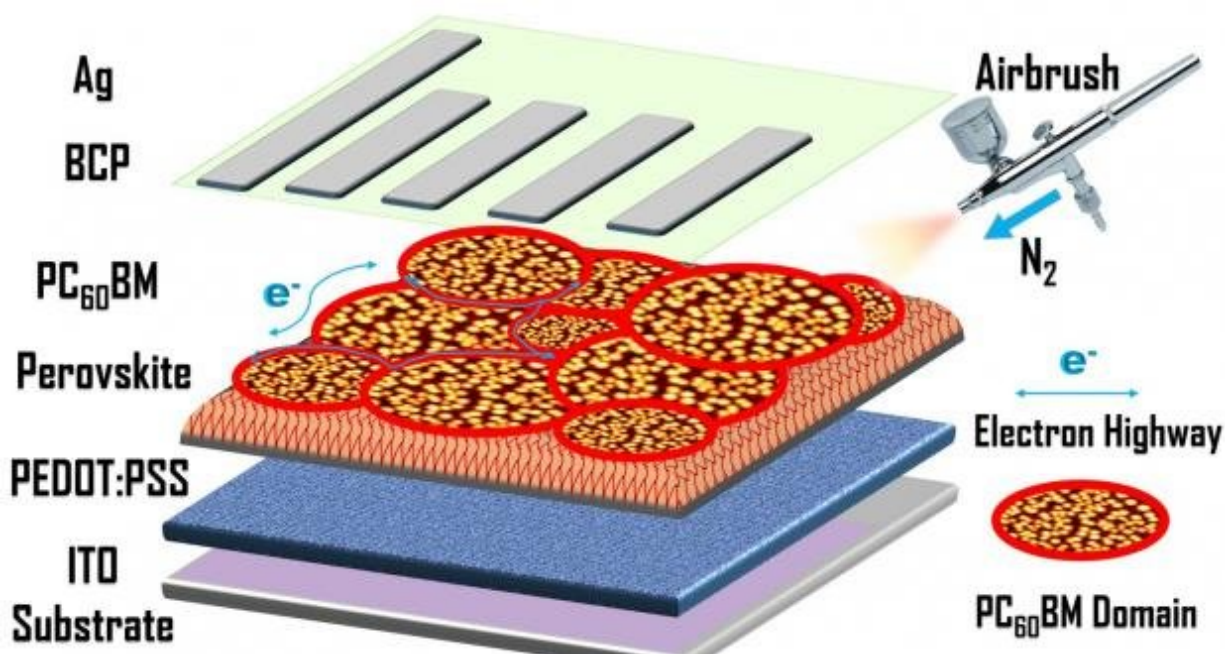


Researchers solve major challenge in mass production of low-cost solar cells

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A model of a perovskite solar cell, showing its different layers. Professor André D. Taylor has been working to solve fabrication challenges with perovskite cells. Credit: Royal Society of Chemistry, *Nanoscale* (2018). DOI: 10.1039/C8NR01763H

An international team of university researchers today reports solving a major fabrication challenge for perovskite cells—the intriguing potential challengers to silicon-based solar cells.

These crystalline structures show great promise because they can absorb almost all wavelengths of light. Perovskite solar cells are already commercialized on a small scale, but recent vast improvements in their power conversion efficiency (PCE) are driving interest in using them as low-cost alternatives for solar panels.

In the cover article published online today for the June 28, 2018 issue of *Nanoscale*, a publication of the Royal Society of Chemistry, the research team reveals a new scalable means of applying a critical component to perovskite cells to solve some major fabrication challenges. The researchers were able to apply the critical electron transport [layer](#) (ETL) in perovskite photovoltaic cells in a new way—spray coating—to imbue the ETL with superior conductivity and a strong interface with its neighbor, the perovskite layer.

The research is led by André D. Taylor, an associate professor in the NYU Tandon School of Engineering's Chemical and Biomolecular Engineering Department, with Yifan Zheng, the first author on the paper and a Peking University researcher. Co-authors are from the University of Electronic Science and Technology of China, Yale University, and Johns Hopkins University.

Most solar cells are "sandwiches" of materials layered in such a way that when light hits the cell's surface, it excites electrons in negatively charged material and sets up an electric current by moving the electrons toward a latticework of positively charged "holes." In [perovskite solar cells](#) with a simple planar orientation called p-i-n (or n-i-p when inverted), the perovskite constitutes the light-trapping intrinsic layer (the "i" in p-i-n) between the negatively charged ETL and a positively charged hole transport layer (HTL).

When the positively and negatively charged layers are separated, the architecture behaves like a subatomic game of Pachinko in which

photons from a light source dislodge unstable electrons from the ETL, causing them to fall toward the positive HTL side of the sandwich. The perovskite layer expedites this flow. While perovskite makes for an ideal intrinsic layer because of its strong affinity both for holes and electrons and its quick reaction time, commercial-scale fabrication has proved challenging partly because it is difficult to effectively apply a uniform ETL layer over the crystalline surface of the perovskite.

The researchers chose the compound [6,6]-phenyl-C(61)-butyric acid methyl ester (PCBM) because of its track record as an ETL material and because PCBM applied in a rough layer offers the possibility of improved conductivity, less-penetrable interface contact, and enhanced light trapping. "Very little research has been done on ETL options for the planar p-i-n design," said Taylor. "The key challenge in planar cells is, how do you actually assemble them in a way that doesn't destroy the adjacent layers?"

The most common method is spin casting, which involves spinning the cell and allowing centripetal force to disperse the ETL fluid over the perovskite substrate. But this technique is limited to small surfaces and results in an inconsistent layer that lowers the performance of the solar cell. Spin casting is also inimicable to commercial production of large solar panels by such methods as roll-to-roll manufacture, for which the flexible p-i-n planar perovskite architecture is otherwise well suited.

The researchers instead turned to spray coating, which applies the ETL uniformly across a large area and is suitable for manufacturing large solar panels. They reported a 30 percent efficiency gain over other ETLs—from a PCE of 13 percent to over 17 percent—and fewer defects. Added Taylor, "Our approach is concise, highly reproducible, and scalable. It suggests that spray coating the PCBM ETL could have broad appeal toward improving the efficiency baseline of perovskite solar cells and providing an ideal platform for record-breaking p-i-n

[perovskite](#) solar cells in the near future."

More information: Yifan Zheng et al, Spray coating of the PCBM electron transport layer significantly improves the efficiency of p-i-n planar perovskite solar cells, *Nanoscale* (2018). [DOI: 10.1039/C8NR01763H](#)

Provided by NYU Tandon School of Engineering

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