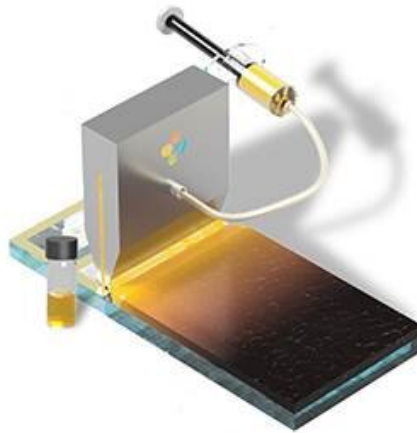


Solar perovskite production on a roll

November 10 2020



Slot-die coating technique used for large-scale fabrication of perovskite solar cells. Credit: KAUST

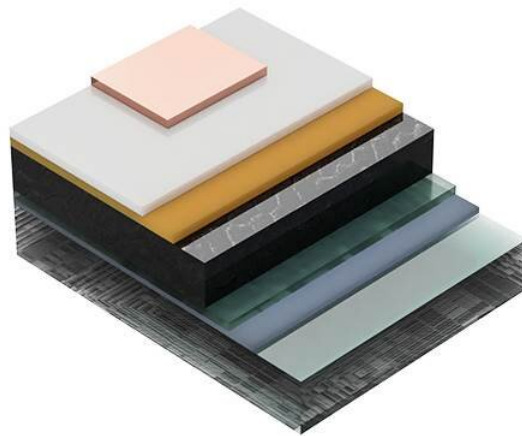
High-performance perovskite solar cells are made using a manufacturing-friendly liquid-based process suitable for roll to roll production.

Advanced ink formulations could be the key to turning perovskite [solar cells](#) (PSCs) from heroes of academic labs into commercially successful products. Researchers at KAUST have developed a perovskite ink tailor-made for a mass manufacturing process called slot-die coating, producing PSCs that captured solar energy with [high efficiency](#). The ink

could also be coated onto silicon to create perovskite/silicon tandem solar [cells](#) that capture even more of the sun's energy.

"PSCs have shown a lot of promise in lab-scale work over the past decade," says Anand Subbiah, a postdoc in Stefaan De Wolf's lab. "As a community, we need to start looking at the stability and scalability of PSC technology," he says.

PSCs made in research labs are typically made by spin-coating, which is unsuited to mass manufacture. Slot-die coating, in contrast, is a manufacturing technique used industrially for almost 70 years. "The process involves continuously and precisely forcing an ink through a narrow slit that is moved across the substrate to form a continuous film," Subbiah says. "This high-throughput technique would allow for roll-to-roll fabrication, similar to printing newspapers."



The planar p-i-n device architecture of the perovskite solar cell employed in the study. Credit: KAUST

To produce high-efficiency slot-die coated PSCs, the team faced several challenges. Some of the best-performing spin-coated PSCs combine the perovskite with a poly(triarylamine) (PTAA) transport layer, but PTAA is hydrophobic and highly repellent to liquid perovskite ink. Adding a surfactant to the ink formulation overcame the repellence, resulting in better quality interface and films and better device performance, Subbiah says. The team also switched the ink to a lower-boiling solvent, reducing ink drying time without the need for further processing steps.

Overall, the team's optimized slot-die coated PSCs captured [solar energy](#) with up to 21.8 percent efficiency, a significant improvement over the 18.3 percent previously recorded for PSCs made this way.

Even more significantly, from a commercial standpoint, was that the ink could readily be coated onto textured silicon to produce a perovskite/silicon tandem solar cell, Subbiah says. "We were also able to make the very first slot-die coated silicon-[perovskite](#) monolithic tandem solar cell, recording a 23.8 percent efficiency," he says.

"The development of scalable deposition techniques for [perovskite solar cells](#) is essential to bring this technology from the research labs to the market," De Wolf says. "Our next steps are making large-area devices and modules using our developed technology and testing their stability in the lab and the outdoors, while continuing to improve performance."

More information: Anand S. Subbiah et al. High-Performance Perovskite Single-Junction and Textured Perovskite/Silicon Tandem Solar Cells via Slot-Die-Coating, *ACS Energy Letters* (2020). [DOI: 10.1021/acseenergylett.0c01297](https://doi.org/10.1021/acseenergylett.0c01297)

Provided by King Abdullah University of Science and Technology

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