Chemical innovation stabilizes best-performing perovskite formulation

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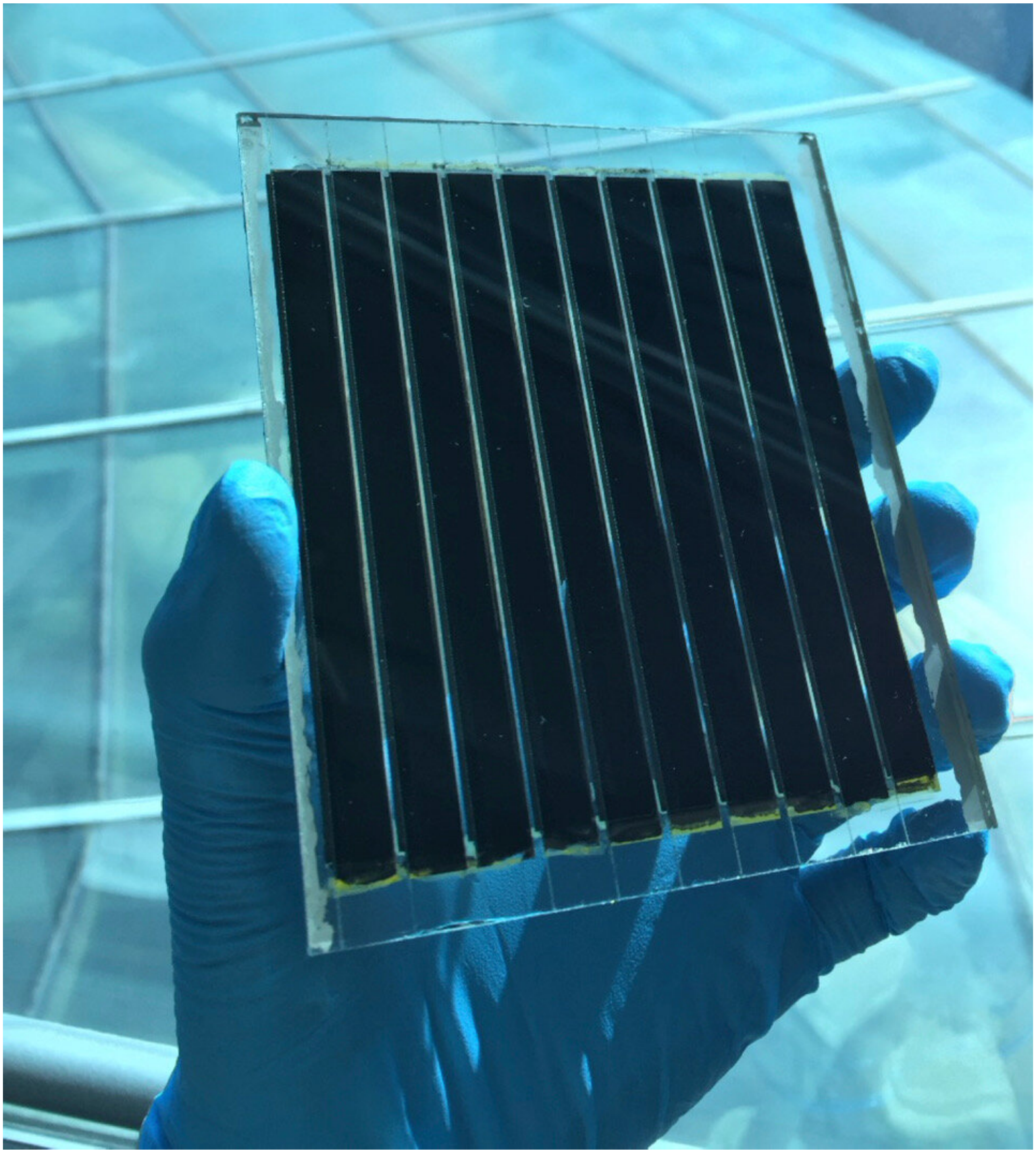

Publishing in *Science*, researchers at EPFL have successfully overcome a limiting problem with stabilizing the best-performing formulation of metal-halide perovskite films, a key player in a range of applications, including solar cells. Credit: Nripan Mathews NTU, Singapore

Perovskites are a class of materials made up of organic materials bound to a metal. Their fascinating structure and properties have propelled perovskites into the forefront of materials' research, where they are studied for use in a wide range of applications. Metal-halide perovskites are especially popular, and are being considered for use in solar cells, LED lights, lasers, and photodetectors.

For example, the power-conversion efficiency of perovskite solar cells (PSCs) have increased from 3.8% to 25.5% in only ten years, surpassing other thin-film solar cells—including the market-leading, polycrystalline silicon.

Perovskites are usually made by mixing and layering various materials together on a transparent conducting substrate., which produces thin, lightweight films. The process, known as "chemical deposition," is sustainable and relatively cost-effective.

But there is a problem. Since 2014, metal halide perovskites have been made by mixing cations or halides with formamidinium ($FAPbI_3$). The reason is that this recipe results in high power-conversion efficiency in perovskite solar cells. But at the same time, the most stable phase of FAPbI3 is photoinactive, meaning that it does not react to light—the opposite of what a solar power harvester ought to do. In addition, solar cells made with FAPbI3 show long-term stability issues.

Now, researchers led by Michael Grätzel and Anders Hafgeldt at EPFL, have developed a deposition method that overcomes the formamidinium issues while maintaining the high conversion of perovskite solar cells. The work has been published in *Science*.

In the new method, the materials are first treated with a vapor of methylammonium thiocyanate (MASCN) or formamidinium thiocyanate FASCN. This innovative tweak turns the photoinactive $FAPbI_3$

perovskite films to the desired photosensitive ones.

The scientists used the new $FAPbI_3$ films to make perovskite solar cells. The cells showed more than 23% power-conversion efficiency and long-term operational and thermal stability. They also featured low (330 mV) open-circuit voltage loss and a low (0.75 V) turn-on voltage of electroluminescence.

More information: "Vapor-assisted deposition of highly efficient, stable black-phase $FAPbI_3$ perovskite solar cells" *Science* (2020). science.sciencemag.org/cgi/doi … 1126/science.abb8985

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