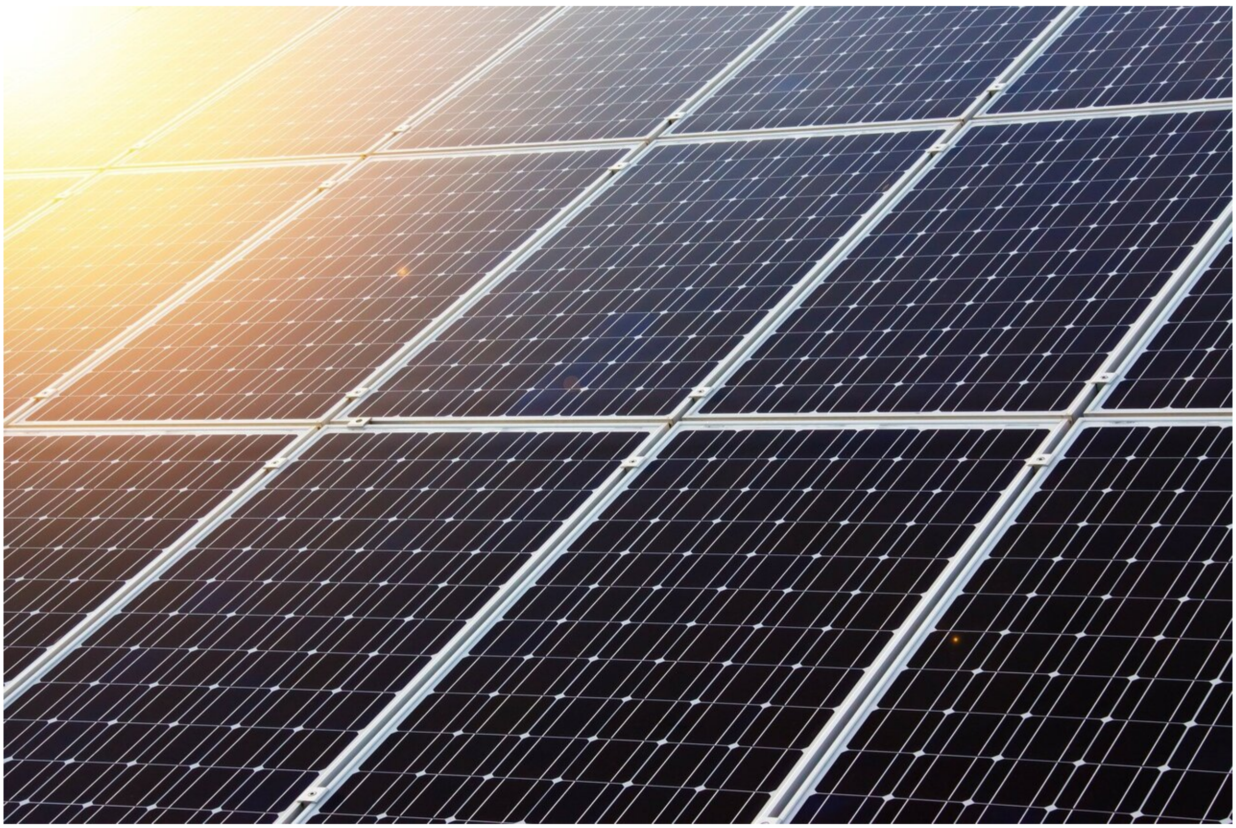
Scientists create stable materials for more efficient solar cells

December 15 2021



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Researchers from Queen Mary University of London have developed a new process for producing stable perovskite materials to create more efficient solar cells.

Crystalline silicon is the most widely used material for solar cells. However, over the last decade, perovskite solar cells, made from metal halide perovskite materials, have shown promise to make cheaper, and potentially more efficient solar cells than silicon.

But while perovskite solar cells can now compete in terms of efficiency with more established silicon based solar cells, a key challenge that remains unaddressed is their chemical instability. Perovskite materials are very sensitive to moisture, oxygen and even light, meaning they can degrade rapidly in air.

One perovskite material, formamidinium perovskite, could help to solve this issue as its pure, black- colored crystal structure, known as $FAPbI_3$, is more chemically stable than many other perovskites. Its optical properties are also much better suited to absorb light and produce electricity efficiently in a solar cell than existing perovskite materials. However, creating this black, stable form of the material is difficult, and it can often instead form a yellow phase that isn't suitable for solar cells.

In the study, published in the journal *Advanced Materials*, researchers describe a new process for creating $FAPbI_3$. One of the challenges with making $FAPbI_3$ is that the high temperatures (150 degrees Celsius) used can cause the crystals within the material to "stretch," making them strained, which favors the yellow phase. And while some previous reports have used small amounts of additional chemicals to help form $FAPbI_3$under these conditions, it can be very hard to control the uniformity and amounts of these additives when making solar cells at a very large scale, and the long-term impact of including them is not yet known.

The novel approach described in the study instead exposes films of $FAPbI_3$ to an aerosol containing a mixture of solvents at a lower temperature (100 degrees Celsius). The researchers found that they could form very stable black-phase $FAPbI_3$ after just one minute, in comparison to other approaches that can take around 20 minutes. They also show that the lower temperatures used help to "relax" the crystals within the material.

Dr. Joe Briscoe, Reader in Energy Materials and Devices at Queen Mary, said: "Pure formamidinium perovskite could produce perovskite solar cells that are more efficient and stable than those made with other commonly used hybrid perovskites based on methylammonium. This could be really important for commercializing this technology, particularly as the process can easily be scaled up."

"In this study, we've demonstrated a novel, more efficient approach to create pure and stable black formamidinium perovskite $FAPbI_3$. As our process uses an 'inverted' perovskite solar cell structure and lower annealing temperature, this also makes it very suitable for making flexible solar cells on plastic, which could have a lot of applications for example in clothing and vehicles."

More information: Tian Du et al, Additive-free, Low-temperature Crystallization of Stable α -FAPbI 3 Perovskite, *Advanced Materials* (2021). DOI: 10.1002/adma.202107850

Provided by Queen Mary, University of London