Stable solar cells from perovskite

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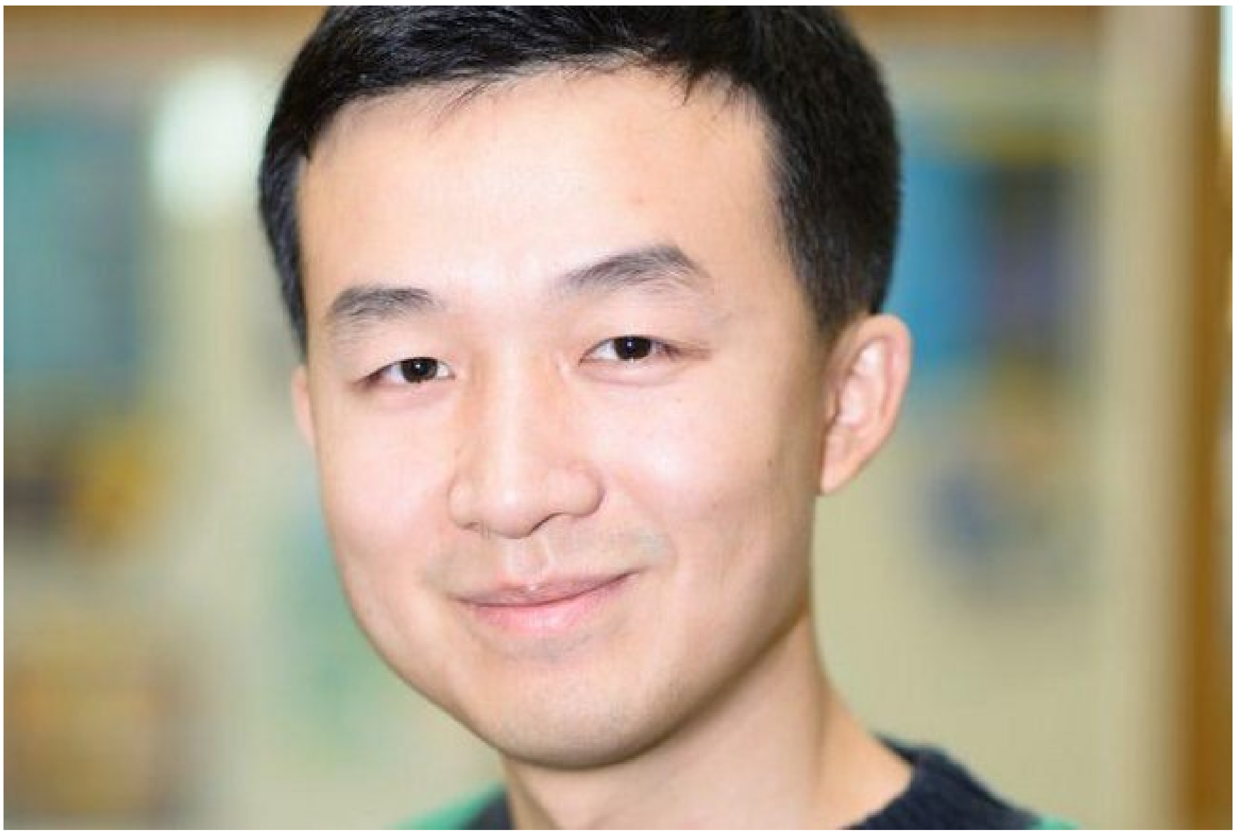

Junke Jiang. Credit: Eindhoven University of Technology

Perovskite is a promising material. It captures the sun's rays and efficiently converts them into solar energy. It is also much cheaper than the current generation of silicon solar cells. But why are the Dutch rooftops not yet massively filled with solar cells of perovskite to capture solar energy? "Perovskite has a rather soft structure that easily changes phase," says TU/e researcher Junke Jiang. He was therefore looking for a way to make the relatively cheap solar cells of perovskite more stable and therefore more efficient.

"Perovskite is a very suitable material for use in solar cells. It captures solar cells very effectively," says Junke Jiang, doctoral candidate at the Department of Applied Physics. "But its soft structure and the different phases it can go into also make it an enormously difficult material to get stable." That stability, however, is necessary to ensure that the material becomes profitable. Because only then can you make solar cells from perovskite cheaply and on a large scale. Only, how do you then discover how such a fragile material remains stable?

Cooking

"You can compare it a bit to cooking," says the researcher. "If you want to make a complicated dish, you also look at how much salt or vinegar you need to add to make sure it's tasty and doesn't fall apart. It's no different with perovskite: there, too, you mix different materials together to discover the strongest compound."

The TU/e researcher didn't stand in the lab like some kind of cook performing experiments. No pinch here and pinch there. He wanted to dissect the perfect "recipe." And thus understand the theory of what makes perovskite remain stable and become as efficient as possible. To do this, he dissected the smallest details. "There has been a lot of experimentation with the material before, but what exactly happens to perovskite during all those experiments was unclear. And that's what you want to know." Jiang therefore performed calculations to understand at the molecular and atomic level what is going on in the material during mixing. To dissect theory from practice and gain a fundamental understanding of the material.

Ideal binder

For example, he discovered that $Rb_yCs_{1-y}Sn(BrxI_{1-x})_3$ perovskites are promising candidates for applications in solar cells if you incorporate a reasonable amount of Rubidium and Broom. Further, for $CsSn_{0.6}Pb_{0.4}I_3$ perovskite quantum dots, adding sodium as a binding agent makes the material stronger and more efficient. The TU/e researcher did all the calculations, a lab in Japan performed the experiments to see if it worked in practice. "Then it turned out that the material boosted the efficiency." The researcher was very happy with the result. "But it's still not enough, because of course you want it to be even higher. But this is the first step towards that."

More information: Stabilizing metal halide perovskites by computational compositional engineering. research.tue.nl/en/publication … tational-composition

Provided by Eindhoven University of Technology