Solar cells more efficient thanks to new material standing on edge

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Researchers from Lund University in Sweden and from Fudan University in China have successfully designed a new structural organization using the promising solar cell material perovskite. The study shows that solar cells increase in efficiency thanks to the material's ability to self-organise by standing on edge.

The current research study deals with perovskite, a new and promising material in the context of solar cells. However, in its regular form, the material is very sensitive to moisture. It simply dissolves in contact with water, and even normal humidity deteriorates the material within hours or minutes. Now the researchers appear to have overcome that problem.

"We have succeeded in producing thin sheets with a water-repelling surface, making the whole construction much more stable. In addition, we have succeeded in orienting the sheets so as to obtain acceptable solar cells, with an efficiency of ten per cent", says Tönu Pullerits, professor of chemical physics at Lund University.

Tönu Pullerits sees great development potential for solar cells based on perovskite, thanks to the outcome of the current study. The researchers not only built thin sheets out of the material to achieve water-repelling surfaces but also discovered, to their surprise, that these perovskite sheets self-organised in a way that clearly increased efficiency.

Since the sheets are so thin, many need to be layered on top of each other in order for the absorption of sunlight to be sufficient. A problem

arises at this point in that the water-repelling surfaces do not allow electrons to circulate freely within the material. It becomes difficult for the electrons to jump from one sheet to another, which reduces efficiency in the solar cells.

The researchers first tested two different water-repelling surfaces. They expected one version to give better results, enabling the electrons to jump more easily from one sheet to another. Instead, the outcome was the opposite – the second version gave much better results. This surprised the researchers, who then started new experiments in order to understand why.

"Here, our laser experiments were crucial. We could show that the sheets with the second surface material self-organised in such a way as to stand on edge instead of lying flat against one another", says Tönu Pullerits.

Thanks to the self-organising structure of the sheets, the electrons were able to move freely between the contacts, considerably increasing the efficiency of converting the solar energy to electricity. Tönu Pullerits sees the result as an important step on the way to constructing stable and efficient solar cells out of perovskite.

"Stability is a key issue for solar cells", he says.

More information: Yani Chen et al. Tailoring Organic Cation of 2D Air-Stable Organometal Halide Perovskites for Highly Efficient Planar Solar Cells, *Advanced Energy Materials* (2017). DOI: 10.1002/aenm.201700162

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