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## ***Time for perovskites***

*What should be a dream solar panel? Efficient, cheap to produce, durable, flexible and eco-friendly. All these we can get thanks to perovskites: new material offering energy conversion efficiency comparable to silicon panels but much cheaper to produce with simple technology. New research done at IPC PAS in collaboration with EPFL, Switzerland, brings us closer to commercializing this technology.*

Have you ever wished for charging your phone while hiking? Or maybe just one thing prevented you from becoming a prosumer – lack of roof suitable for installing solar panels? If you wait a little, your dreams may come true thanks to perovskites. Metal halide perovskites have emerged as leading cost-effective candidates for light harvesting materials in solar panels over the last few years. What you may see today on roofs or special photovoltaic installations are silicon cells. They are quite thick and rigid, and production requires a lot of time, very high temperature and high-end technologies. All this means – high costs. In turn, perovskites are relatively simple and cheap to produce and their synthesis does not require complicated and expensive apparatuses. While being cheap to produce, perovskite offers energy conversion efficiency comparable to silicon photovoltaics (even though the latter has been researched for over 40 years, it still does not exceed 27%) and efficiency records are going up. At the start, in 2009, perovskite's efficiency was at 3,9%. “A decade later we've reached a momentary efficiency of 24,2%” says Rashmi Runjhun. “It can potentially go as high as 31% and with tandem architectures the efficiency can be pushed even higher”, adds the scientist, “and isn't the efficiency what everybody is now looking for?” According to Runjhun that's why perovskites have such huge industrial potential. After all, one just needs to get a few of fairly available chemical compounds, mix them together to create a solution, make a film, and then anneal it - crystallize it to make the current flow better.

The PhD student of NaMeS\* hopes that in the near future, thanks to her and other researchers, photosensitive layers made of perovskites will be put on various, including flexible and elastic surfaces, such as uneven, irregular walls, roofs or even clothes. Maybe we'll even invent wall paint that will generate energy. Research done at IChF PAN in collaboration with EPFL, Switzerland, will certainly help it. Thanks to a slight change in the components of the perovskite solution scientists managed to increase the power conversion efficiency from 15 to over 20%. The increase stems from increased grains of the active layer as well as from better separation of charge. The team also managed to increase the carrier lifetime inside the perovskite layer and also increase their stability.

These results were described in a recent paper published in “Chemistry of Materials”.

Remaining challenges? “Make new perovskite solar cells more ecological, as for now they are based on toxic lead element,” adds the supervisor of this project prof. Janusz Lewiński. And what’s the dream solar panel according to Rashmi Runjhun? Of course it should be efficient, but also cheap to produce, durable (with at least 10 years of good activity) and eco-friendly. And, of course, easy to put on flexible substrates. So one could for example put photosensitive layer on fabrics. This way we wouldn’t have to worry about camping unplugged.

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The Institute of Physical Chemistry of the Polish Academy of Sciences (<http://www.ichf.edu.pl/>) was established in 1955 as one of the first chemical institutes of the PAS. The Institute's scientific profile is strongly related to the newest global trends in the development of physical chemistry and chemical physics. Scientific research is conducted in nine scientific departments. CHEMIPAN R&D Laboratories, operating as part of the Institute, implement, produce and commercialize specialist chemicals to be used, in particular, in agriculture and pharmaceutical industry. The Institute publishes approximately 200 original research papers annually.

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#### **SCIENTIFIC PAPERS:**

« Engineering of Perovskite Materials Based on Formamidineum and Cesium Hybridization for High-Efficiency Solar Cells », Daniel Prochowicz, Rashmi Runjhun, Mohammad Mahdi Tavakoli, Pankaj Yadav, Marcin Sasaki, Anwar Q. Alanazi, Dominik J. Kubicki, Zbigniew Kaszukur, Shaik M. Zakeeruddin, Janusz Lewiński, and Michael Grätzel

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DOI: 10.1021/acs.chemmater.8b04871

#### **LINKS:**

<http://www.ichf.edu.pl/>  
The website of the Institute of Physical Chemistry of the Polish Academy of Sciences.

<http://www.ichf.edu.pl/press/>  
Press releases of the Institute of Physical Chemistry of the Polish Academy of Sciences.

#### **IMAGES:**

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Research is being carried out at the Institute of Physical Chemistry PAS on improving the efficiency of perovskite solar surfaces - ecological, cheap and universal in application.  
(Source: IPC PAS, Grzegorz Krzyzewski)

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PhD student Rashmi Runjhun working on the modification of chemical compounds included in the composition of innovative photosensitive layers with promising industrial potential.  
(Source: IPC PAS, Grzegorz Krzyzewski)