How to obtain highly crystalline organic-inorganic perovskite films for solar cells

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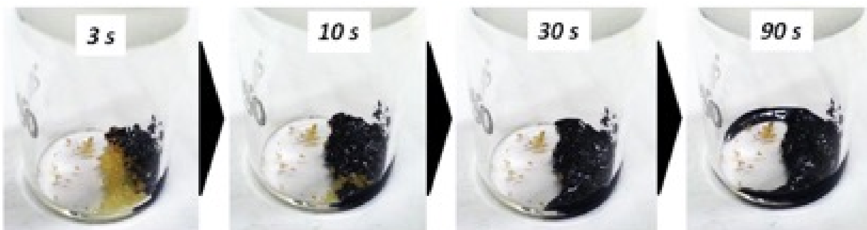
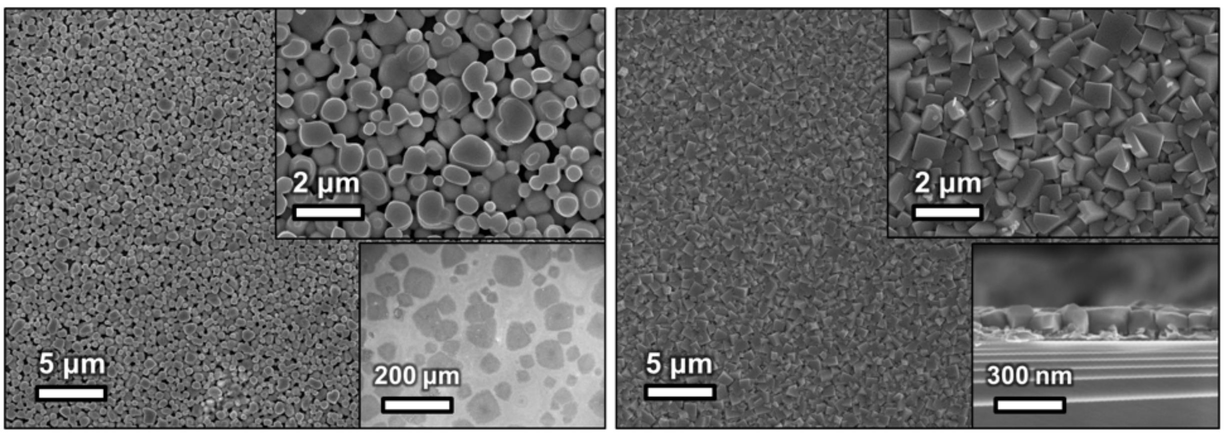


Upon contact of two chemical agent powders at room temperature a viscous dark liquid is formed in a matter of seconds. This is methylammonium polyiodides. Credit: Alexey Tarasov

Members of the Laboratory of New Materials for Solar Energetics, working at the Faculty of Material Sciences, in cooperation with their colleagues from the Faculty of Chemistry of the Lomonosov Moscow State University have obtained highly crystalline organic-inorganic perovskite films for solar cells. Their results are published in the journal *Materials Horizons*.

The researchers previously worked on nanowires of hybrid organic-inorganic perovskites, which are promising for the creation of light emitting diodes, lasers and photodetectors. However, the most promising application for these substances is the elaboration of perovskite solar cells—namely, next-generation photovoltaic devices. Efficiency of these devices has risen by several times over the last five years, and now comprises even more than 22 percent. This is significantly higher than the maximum efficiency of polycrystalline silicon solar cells. Efficiency of the most popular industrially produced solar cells is 12 to 15 percent.

There are two main approaches for obtaining this material. The first involves a coating of vaporous chemical agents, and the second is solution crystallization. Projects aimed at improving these methods have been intensively developed in recent years. However, further perspectives of these approaches are almost exhausted.



Microphotos of perovskite films of various morphology obtained by the elaborated technique. Credit: Alexey Tarasov

Alexey Tarasov, Doctor of Chemistry, the Head of the Laboratory and the Study Lead says, "As part of the study, we've found several new compounds—polyiodides, which are liquid at room temperature, and have unique properties. They look like viscous liquids of dark brown color with a metal gleam, obtained from two solid powders, which simply melt while blending. Their liquid state makes them a good substitute for hazardous solvents and, their chemical composition contributes to the formation of a necessary perovskite upon contact with a metallic lead film or other lead compounds. As a result of the chemical interaction between lead film and polyiodide melts, a perovskite film composed of large interpenetrating crystals is formed."

Polyiodide melts are deposited on lead using a so-called spin coating technique. For this purpose, a glass substrate with lead layer is fixed on a whirling rod and rotates. Polyiodide is poured on the whirling glass substrate and the residue is flushed using isopropanol. This produces stable perovskite films from 200 to 700 nm in thickness.

The lab currently continues studying properties of discovered polyiodides and elaborating technologies to obtain solar cells with high efficiency.

More information: Andrey A. Petrov et al, A new formation strategy of hybrid perovskites via room temperature reactive polyiodide melts, *Mater. Horiz.* (2017). DOI: 10.1039/C7MH00201G

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