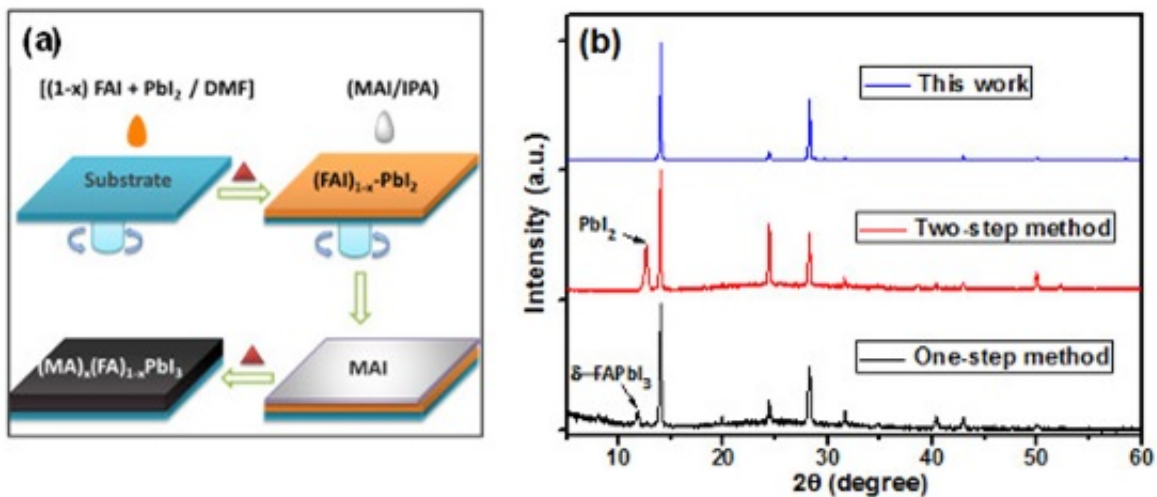


High-quality perovskite materials developed capable of utilizing long-wavelength sunlight

November 2 2015



(a) Fabrication method for a high-quality perovskite material; (b) X-ray diffraction patterns of perovskite materials prepared with different methods. The x-axis represents the intensity of X-ray diffraction while the y-axis denotes the X-ray diffraction angle.

A NIMS research team led by Liyuan Han, director of the Photovoltaic Materials Unit, has developed the world's first method to fabricate high-quality perovskite materials capable of utilizing long-wavelength sunlight of 800 nm or longer. Compared to conventional methods, this method enables the creation of perovskite materials that have a 40-nm wider optical absorption spectrum, a high short-circuit current and high open-circuit voltage. Thus, this method is regarded as a new approach to

enhance the efficiency of perovskite solar cells.

The currently available [perovskite solar cells](#) possess optical absorption spectra skewed toward shorter wavelengths. To improve the [energy conversion efficiency](#) of these cells, it is vital to develop [perovskite materials](#) with optical absorption spectra expanded to include longer wavelengths. Accordingly, several research institutes are developing perovskite materials, $(\text{MA})_x\text{FA}_{1-x}\text{PbI}_3$, which include two types of cations, MA and FA, capable of absorbing light in the longer wavelength region. However, these cations have demerits: their mixing ratio and crystallization temperature are difficult to control. Moreover, due to their tendency to form a mixed crystal phase, there had been no effective method established to fabricate high-purity, single-crystalline perovskite materials.

To resolve these issues, we developed a new method to fabricate a new type of mixed cation-based perovskite material. We first fabricated a pure, single-crystalline precursor material, $(\text{FAI})_{1-x}\text{PbI}_2$, under altering temperatures. Then, we performed a reaction between the precursor and MAI (methylammonium iodide). The resulting perovskite material, $(\text{MA})_x\text{FA}_{1-x}\text{PbI}_3$, was a single crystalline phase and had a long fluorescence lifetime. These observations indicated that electrons in the material rarely recombine and they have long lifetimes. The [optical absorption](#) spectrum of the [solar cells](#) employing this material covered up to 840 nm, which was 40 nm wider than the spectrum of conventional perovskite material (MA_3PbI_3). As a result, the solar cells we developed obtained 1.4 mA/cm² higher short-circuit current than the MAPbI_3 solar cells that were manufactured under the same conditions.

In future studies, we intend to develop high-quality perovskite solar cells capable of utilizing a broader spectrum of sunlight by adjusting the ratio of the two cations.

More information: Jian Liu et al. High-Quality Mixed-Organic-Cation Perovskites from a Phase-Pure Non-stoichiometric Intermediate (FAI) -PbI for Solar Cells , *Advanced Materials* (2015). [DOI: 10.1002/adma.201501489](https://doi.org/10.1002/adma.201501489)

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