Wet Chemistry of mixed cation for high efficiency and stable perovskites using combinatorial material science

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As an emerging photovoltaic technology, hybrid perovskite solar cells have attracted enormous research attention because of their ease of fabrication and high power conversion efficiencies. A typical formula for the hybrid perovskite is ABX_3, where A stands for cation such as MA, FA, Rb, and Cs, B is a metal, and X represents a halogen anion). However, $MAPbI_3$ and $FAPbI_3$ have different properties such as thermal stability, moisture-related degradation, and hysteretic I−V behavior. The incorporation of MA, Cs, and Rb stabilizes the perovskite structure, resulting in better PV performance. These facts indicate that using mixed cation perovskites combined with high-throughput experimentation can lead us to improved perovskites. As such, development of new mixed-cation perovskites, with lower bandgaps as absorbers and better stability for solar cells is important.

In this work, combinatorial material science was used, to form $FA_xMA_{1-x}PbI_3$, as an opening shot for further development and research capabilities. The $FA_xMA_{1-x}PbI_3$ was synthesized in a combinatorial library by dip-coating of a $MAPbI_3$ film in a solution of FAI dissolved in 2-propanol (Cation Exchange). Optical characterizations reveal that the obtained bandgaps for the change from $MAPbI_3$ to $FA_xMA_{1-x}PbI_3$ is 0.19 eV, allowing fine tuning of the bandgap. The cation exchange process was characterized by x-ray diffraction (XRD) and PL measurements The capability of tunable bandgaps by different ratio of the mixed-cation in a perovskite indicate its potential to be used as a new technique to get better absorber materials in photovoltaic devices.