High Efficiency and Stable Perovskite Solar Cells

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Abstract: Lead halide perovskite solar cells have become one of most promising alternative photovoltaics with efficiency comparable to Si solar cells. The stabilities are the main challenge for commercialization of perovskite photovoltaics. The volatile organic cations would lead to the chemical degradation of perovskite solar cells. Therefore, various approaches has been developed to stabilize the A site cations including reduced dimension and MA locker designation and mixed cation perovskite etc. Among them, the all-inorganic lead halide perovskite without volatile component would be a promising alternative candidate for high efficiency photovoltaics. However, the all-inorganic black phase $CsPbI_3$ face the challenges of low room temperature phase stability and relative low efficiency. To enhance the performance and stability of all-inorganic $CsPbI_3$ perovskite, the 2D/3D configuration was introduced to stabilize the black phase $CsPbI_3$. The 2D based on $EDAPbI_4$ help stabilize black phase $CsPbI_3$ to achieve up to >11% efficiency. Furthermore, a facile organic cation surface termination approach was developed to significantly enhance the stability and performance of α-$CsPbI_3$ solar cell with >15% efficiency. The bifunctional stabilization of $CsPbI_3$ with gradient Br doping and organic cation termination finally improve the efficiency of $CsPbI_3$ perovskite solar cells to a record value of 17% with enhanced stabilities. Recently, a concept new beta phase $CsPbI_3$ with better phase stability push the efficiency up to 19%. In all, the $CsPbI_3$ perovskite would be an ideal candidate for stable and efficient perovskite photovoltaics.

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Biography:

Yixin Zhao is a professor at Shanghai Jiao Tong University. He graduated from Shanghai Jiao Tong University with B.S. and M.S. degrees in chemistry and received his Ph.D. degree from Case Western Reserve University in 2010, followed by working as a postdoctoral fellow at Penn State University and the National Renewable Energy Laboratory. His current research interests focus on perovskite solar cells and perovskite-based functional materials for solar energy conversion and environmental remediation application.