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Enhanced Performance via Partial Lead Replacement by Calcium for $CsPbI_3$ Perovskite Solar Cell

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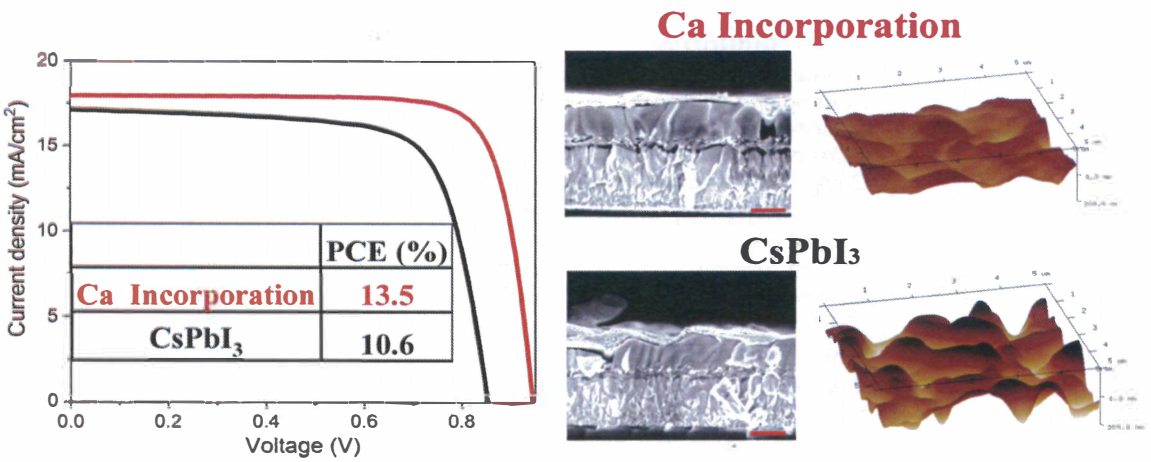
Cesium metal halides are potential light-harvesting materials as a top cell in multi-junction devices due to their suitable bandgap and good thermal stability. In particular, $CsPbI_3$ has a bandgap of 1.7eV which is suitable for perovskite/Si tandem. However, the desirable black phase for CsPbI3 is not stable because Cs is too small to support the PbI_6 octahedra. Also, there is room for improvement in terms of cell performance. Herein, we partially replace Pb^{2+} with Ca^{2+} in the $CsPbI_3$ precursor producing multiple benefits. Firstly, more uniform films with larger grains are produced from CsPbI3 with Ca^{2+}, due to the reduction in the size of colloidals in the precursor solution with Ca^{2+}. This morphology improvement provides a better contact at the interface between perovskite and the hole transport layer. In addition, it is found that the surface of the film is modified by a formation of Ca rich oxide layer, providing a surface passivation effect. Finally, the incorporation of Ca increases the band gap, leading to increase in output voltage. The best CsPbI3 solar cell using 5% Ca^{2+} substitution in the precursor achieves a stabilised efficiency of 13.3%, and maintains 85% of its initial efficiency over 2 months with encapsulation.



References

1.C. F. J. Lau, X. Deng, J. Kim, J. Zheng, Z. Zhang, M. Zhang, J. Bing, B. Wilkinson, H. Long, R. Patterson, M. A. Green, S. Huang, and A. W.Y. Ho-Baillie "CsPbI3 Perovskite Solar Cell exceeding 13% Power Conversion Efficiency", JMCA, 2018, 6, 5580-5586