The effect of mixed- solvent and Br doping ratio of wide band gap perovskite layers for perovskite solar cells

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Photovoltaic cells could boost the efficiency from ~20% toward 30% when used in tandem architectures with silicon photovoltaic cells. An optimum optical band gap of top cell is ~1.71 electron volts (eV). Here we present the study of different perovskite precursor solvent (DMSO/GBL) ratio and different amount of Br doping on perovskite material, $[HC(NH_2)_2]_{0.8}Cs_{0.2}Pb(I_{1-x}Br_x)_3$, with desire band gap and efficiency combination. The perovskite photovoltaic cells with 1.71eV band gap we fabricated that reached open-circuit voltages of 1.17 volts and power conversion efficiency of 14.2%.

Our method of fabricate perovskite layer is one-step spin coating, so the solvent of perovskite precursor solution is an important factor that affect the PV performance. In this work, we present the different mixed-solvent ratio of Dimethyl sulfoxide (DMSO) and γ-Butyrolactone (GBL), fine out an optimum ratio for the fabrication and use the instrument analysis to explain the results. We also use Br doping to tune the band gap from 1.54eV to 1.71eV, and analysis the characteristic of cells.

Table 1. Photovoltaic performance for different band-gap

Device type	**Material**	**Bandgap (eV)**	**Eg/e-V_{oc} (mV)**	**V_{oc} (V)**	**J_{sc} (mA/cm^2)**	**PCE (%)**
p-i-n	$Cs_{0.2}FA_{0.80}Pb(I_{0.80}Br_{0.20})_3$ with Interface modified	1.65	500	1.15	18.12	15.8
p-i-n	$Cs_{0.2}FA_{0.80}Pb(I_{0.80}Br_{0.20})_3$ with Interface modified	1.71	540	1.71	16.02	14.28

Reference

[1] D. P. McMeekin *et al*., A mixed-cation lead mixed-halide perovskite absorber for tandem solar cells, *Science*. **351**, 151-155 (2016).

[2] V. Sivaram, S. D. Stranks, H. J. Snaith, *Sci. Am*. **313**, 54 -59 (2015).

[3] M. A. Green, K. Emery, Y. Hishikawa, W. Warta, E. D. Dunlop, *Prog. Photovolt. Res. Appl.* **23**, 805-812, (2015).