Optimization of wide-bandgap perovskite to improve the performance of all perovskite tandem solar cells

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Introduction

All perovskite tandem solar cells (APTSC) are now getting great attention from solar cell community because of the rapid growth in power conversion efficiency (PCE) to >27% [1] since its first demonstration of <5% [2]. Tandem structure consists of two main parts, the narrow bandgap cell and the wide bandgap cell, ideal bandgaps of 1.2-1.3 eV and 1.7-1.8 eV respectively are necessary for achieving highest possible PCEs. The rapid advancement in PCE of APTSCs is credited to the efforts of scientists working on improving the PCE of narrow bandgap tin-lead perovskite solar cells (TLPSCs) despite presence of unstable tin component. The open circuit voltage (Voc) loss has been reduced significantly and now approaching to the Schockley-Queisser (SQ) limit [3]. Therefore, at present, the research demands improvement in performance of wide bandgap solar cells, specially from the viewpoint of decrease in Voc loss. In this work, we concluded that high voltage-loss in wide-bandgap solar cell is the bottleneck in further improvement of tandem solar cells that need to overcome. Apart from this, halide segregation is one of the key issues that need to be solved. Therefore, in our work we highlighted these drawbacks and the strategies to overcome the issues.

Results and discussion

Figure1. shows the IV characteristic of different wide bandgap (1.77 eV) solar cells fabricated in the study. The reference cell exhibited at Voc loss of 0.6V that can be overcome by the interfacial engineering as shown. The best cell obtains a PCE of 16.21% with a reduced Voc loss of 0.56V. As a result, the tandem solar cell showed PCE near to 24%, higher than individual cells.

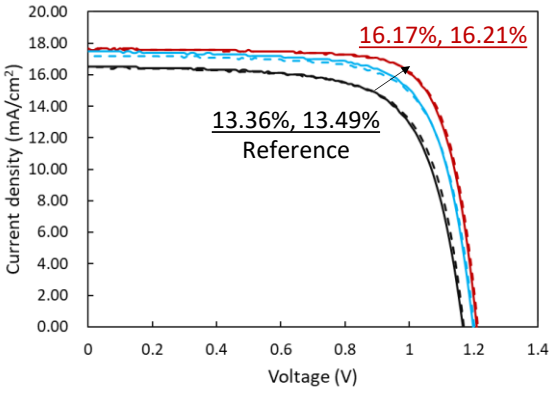

Figure1.Current-voltage characteristics of different solar cells fabricated.

References

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