Boosting the power conversion efficiency of perovskite solar cells by adopting integrated-back-contacted structure

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Perovskite solar cells (PSCs) have been attracting much attention due to its high performance and low cost. Since the first report on PSCs in 2009, the power conversion efficiency (PCE) of the PSCs has increased rapidly, and reached 22.7% recently.[1] At the same time, the quantum efficiency of the PSCs based on traditional sandwich structure has been approaching 100%. In order to further boost the PCE of PSCs, we propose that adopting the integrated-back-contacted (IBC) structure may help to reduce light loss in PSCs. As shown in Fig. 1(a), in the sandwich-PSCs, the light can be reflected, scattered and absorbed by the glass/ITO/CTL (charge transporting layer) layers before reaching perovskite materials. Whereas in the IBC-PSCs, the light is directly absorbed by the perovskite (Fig. 1(b)). Therefore, the light loss can be largely suppressed by adopting the IBC structure to PSCs.

In this work, we will evaluate the applicability of IBC structure to PSCs by means of numerical simulation method. Base on the results, we conclude that the IBC structure is advantageous over the traditional sandwich structure in many cases. By optimizing the structural parameters of the IBC-PSCs and adopting new fabrication method of the perovskite film, we found that it is possible to fabricate PSCs with more than 10% of improvement over the sandwich structure.[2] Our research provides valuable guidelines for the design and fabrication of highly-efficient IBC-PSCs.

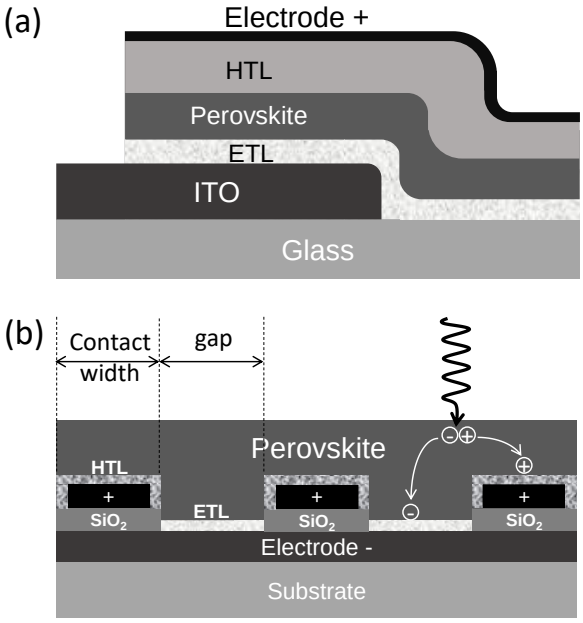

Fig. 1 Schemes of perovskite solar cells with the sandwich (a) and the IBC (b) structure.

[1] Best Research-Cell Efficiency. http://www.nrel.gov/pv/assets/images/efficiency-chart.png (accessed 15/1/2018).

[2] T. Ma, Q. Zhang, D. Tadaki, A. Hirano-Iwata, M. Niwano, *J. Phys. Chem. Lett.* 2017, **8**, 720−726.