Halide Perovskite-based Tandem Solar Cells

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The tandem configuration consisting of two or more solar cells is practically the only approach to overcome the Shockley-Queisser limit. From theoretical calculation shows that the combination of a top cell with a large bandgap energy (1.5~1.7 eV) and a bottom cell with a low bandgap energy (1.0~1.1 eV) can lead to a conversion efficiency higher than 30%. Given that the bandgap energy of most commercial single junction solar cells is around 1.1 eV, the perovskite solar cell with a bandgap energy around 1.6 eV must be a very promising candidate for the top cell of tandem solar cells.

In this presentation, I will discuss the essential requirements for preparing highly efficient perovskite-based tandem solar cells. Firstly, the strategies for improving the performance of the p-i-n type planar perovskite solar cells including transparent devices with a TCO current collecting top layer and non-transparent devices with a conventional metallic current collector will be briefly introduced.[1-3] Secondly, strategies for fabricating and characterizing the highly efficient (~ 24%) tandem solar cells with crystalline Si bottom cells will be discussed.[4] Finally, recent progresses in my lab on the perovskite-based tandem solar cells with non-Si-based bottom cells will be introduced.