The effect of different architectures of TiO_2 as electron transport layer in perovskite solar cells

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Perovskite is a well-studied material over the last few years due to the excellent optoelectronic properties, the low fabrication cost and its application to low-cost high efficiency single and tandem solar cells. A conventional perovskite solar cell requires the use of an electron transport layer (ETL) for the efficient extraction of the photogenerated electrons. The basic criteria for ETL is the favorable band alignment with perovskite and the minimal parasitic optical absorption [1]. TiO_2 seems to be one of the most efficient ETL materials because it can effectively transfer the free electrons and at the same time repel the free holes, thus minimizing recombination effects.

In this work, we compare two different architectures of TiO_2 as ETL in perovskite solar cells. In a first realization, the standard alternation of compact and mesoporous TiO_2 is used as ETL, while in a second realization chemically-synthesized TiO_2 nanorods (NRs) are used instead, having different NR heights [2]. The main goal is to increase the effective area of the TiO_2/perovskite interface and take advantage of the enhanced transport properties of the enhanced structural quality of the TiO_2 NRs.

a) b)

Figure 1. Top-view SEM images of the (a) mesoporous TiO_2 and (b) nanorods TiO_2 surface deposited/grown on FTO/glass.

The TiO_2 layers were characterized by AFM, SEM-EDX, XRD, PL and UV-Vis-NIR spectroscopy. The ETLs were employed in conventional perovskite solar cells [3] and their output performance were tested under AM1.5 solar illumination, compared and analyzed.

References

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