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Semiconductor Nanomaterial for Low-Cost and Stable Perovskite Solar Cell Fabrication.

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Abstract

Development of electron transport layer ETL is one of the most important keys to improve performance and stability of the planar perovskite solar cells (PSCs). Titanium dioxide (TiO_2) has been widely used as an effective electron transport layer. However, its poor conductivity and low electron mobilities limit the performance of planar PSCs. In this work we demonstrate the use of semiconductor nanoparticle SNPs such as zinc cadmium sulfide and silver-indium-sulfide as dopant in TiO_2 electron transport layer in planar PSCs structure. We also develop convective deposition technique to deposit the ETL layer to reduce material consumption and waste obtained by the conventional spin coating. The TiO_2:SNPs electron transport layer shows the improvement of surface morphology, electron mobility, and electron extraction compared with pristine TiO_2. The optimum TiO_2:SNP in FTO/TiO_2:SNPs/Perovskite/Spiro-OMeTAD/Au solar cell structure perform better in terms of power conversion efficiency and stability compared to the one with conventional ETL. In addition, the convective deposition is used to demonstrated large area perovskite film deposition for upscale fabrication of PSCs on rigid and flexible substrate.

Keywords: Perovskite; Electron transporting layer; $AgInS_2$; ZnCdS; TiO_2; Convective Deposition