Nano Res Appl 2018, Volume 4
DOI: 10.21767/2471-9838-C3-015

Low-temperature SnO_2-modified TiO_2 yields record efficiency for normal planar perovskite solar modules

Guan-Jun Yang
Xi'an Jiaotong University, China

Hybrid organic-inorganic perovskite solar cells (PSCs), particularly for the planar PSCs, attracted significant attention because of their high efficiency, low fabrication costs, and simple preparation process. However, planar PSCs exhibit lower efficiency and stability than mesoporous PSCs, primarily owing to defects in the electron transport layer (ETL). Here, we introduce a SnO_2 nanoparticle modified TiO_2 film (SnO_2@TiO_2) as the ETL. In addition, we propose a simple three-step chemical bath method to achieve such SnO_2@TiO_2 structure at low temperatures (140°C). The SnO_2@TiO_2 ETL significantly enhances the electron extraction and decreases the trap states at the perovskite/ETL interface. We achieved average efficiencies at reverse scan and forward scan of 21.27%, 19.79%, 17.21% and 16.31% for device area of 0.10 cm2, 1.13 cm^2, 5.25 cm^2 and 10.56 cm^2 respectively. Besides, we achieved a certificated efficiency of 15.65% for the normal planar perovskite solar module with masked area of 10.55 cm^2. The SnO_2@TiO_2-based PSCs exhibit enhanced photocurrent and reduced hysteresis. Furthermore, the solar cell retained about 89% of its initial efficiency after about 750 hours of aging in dark and about 93% for 528 hours under full-sun illumination. Because of the low-temperature processability and the absence of spin-coating steps, SnO_2@TiO_2 ETLs will provide a promising path for the commercialization of PSCs.

ygj@mail.xjtu.edu.cn