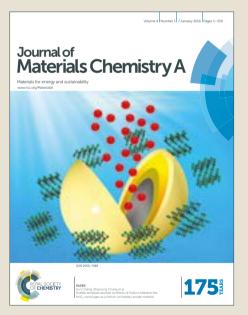


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TiO₂ Embedded Structure for Perovskite Solar Cells with Anomalous Grain Growth and Effective Electron Extraction

Dong Wei,^a Jun Ji,^a Dandan Song^a Meicheng Li,^{a,b*} Peng Cui,^a Yaoyao Li,^a Joseph Michel Mbengue,^a Wenjia Zhou,^c Zhijun Ning,^c Nam-Gyu Park^d

^aState Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources, School of Renewable Energy, North China Electric Power University, Beijing 102206, China. ^bChongqing Materials Research Institute, Chongqing 400707, China

^cSchool of Physical Science and Technology, ShanghaiTech University, Shanghai 201210, China ^dSchool of Chemical Engineering, Sungkyunkwan University, Suwon 440-746, Korea

*Corresponding author: E-mail: mcli@ncepu.edu.cn; Fax: +86 10 6177 2951; Tel: +86 10 6177 2951.

Abstract

The structure of the perovskite solar cells (PSCs) is either mesoporous or planar. Here, a novel structure for highly-efficient and stable PSCs is proposed, i.e., the embedded structure, which combines the advantages of the mesoporous and planar structures. The embedded structure utilizes TiO₂ nanoparticles embedded perovskite (CH₃NH₃PbI₃) film as the absorption layer. The presence of TiO₂ nanoparticles in perovskite film could improve the electron extraction, and promote the formation of a compact perovskite layer with large grains. Consequently, the performance of the PSCs is significantly improved with the efficiency increasing from 16.6% for planar structure to 19.2% for the embedded structure, which is the best performance of the MAPbI₃-based PSCs. Furthermore, the TiO₂ embedded perovskite films present better long-term stability than the pristine perovskite films, and the corresponding PSCs, which have no any other chemical modifications, also show excellent stability with efficiency keeping approach 80% (for average) or 90% (for the best) after being exposed in air for 28 days without encapsulation.

Introduction

Organic-inorganic halide perovskite solar cells (PSCs) possess the advantages of low-cost and high performance, especially the power conversion efficiency (PCE).¹⁻⁶ The outstanding performance of the PSCs both relies on the perovskite itself and the device structure. The structure of the PSCs is either mesoporous or planar, according to with or without mesoporous scaffold layer.^{7,8}

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