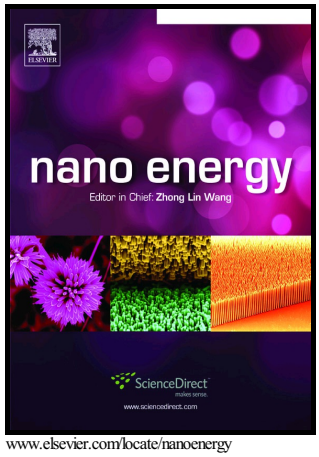

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PII: S2211-2855(18)30590-1
DOI: https://doi.org/10.1016/j.nanoen.2018.08.031
Reference: NANOEN2961

To appear in: *Nano Energy*

Received date: 24 May 2018
Revised date: 11 August 2018
Accepted date: 14 August 2018

Cite this article as: Chao Ding, Yaohong Zhang, Feng Liu, Yukiko Kitabatake, Shuzi Hayase, Taro Toyoda, Kenji Yoshino, Takashi Minemoto, Kenji Katayama and Qing Shen, Effect of the Conduction Band Offset on Interfacial Recombination Behavior of the Planar Perovskite Solar Cells, *Nano Energy,* https://doi.org/10.1016/j.nanoen.2018.08.031

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ABSTRACT

The effects of the conduction band offset (CBO) between the electron selective layer (ESL) and the perovskite layer in planar-heterojunction perovskite solar cells (PSCs) have been systematically investigated for the first time. To obtain different values of CBO, Magnesium doped zinc oxide ($Zn_{1-x}Mg_xO$ (ZMO)) thin films with a tunable conduction band energy level were employed as a model ESL in planar PSCs. We found that the charge recombination at the interface between the ESL and perovskite is strongly dependent on the CBO values: When the *cliff* structure is formed, i.e., when the conduction band minimum (CBM) of the ESL is lower than that of the perovskite, the interface recombination became dominant, and the open-circuit voltage (V_{oc}) worsened. When the *spike* structure is formed, i.e., when the CBM of the ESL is higher than that of the perovskite, the interfacial recombination is largely suppressed, which leads to an increased V_{oc} of the solar cells. Additionally, we found that an appropriate amount of Mg doping in ZnO to form ZMO reduced carrier concentration and improved carrier mobility, thereby enhancing the charge collection efficiency of the photoexcited electrons by the FTO