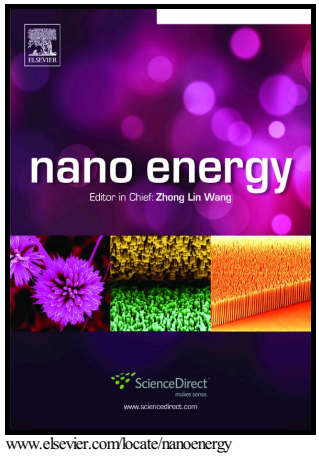

High efficiency non-fullerene organic solar cells without electron transporting Layers enabled by Lewis base anion doping

Rong Wang, Dongyang Zhang, Shenkun Xie, Jianqiu Wang, Zhong Zheng, Donghui Wei, Xiaobo Sun, Huiqiong Zhou, Yuan Zhang

www.elsevier.com/locate/nanoenergy

PII: S2211-2855(18)30510-X
DOI: https://doi.org/10.1016/j.nanoen.2018.07.022
Reference: NANOEN2889

To appear in: *Nano Energy*

Received date: 29 May 2018
Revised date: 11 July 2018
Accepted date: 12 July 2018

Cite this article as: Rong Wang, Dongyang Zhang, Shenkun Xie, Jianqiu Wang, Zhong Zheng, Donghui Wei, Xiaobo Sun, Huiqiong Zhou and Yuan Zhang, High efficiency non-fullerene organic solar cells without electron transporting Layers enabled by Lewis base anion doping, *Nano Energy,* https://doi.org/10.1016/j.nanoen.2018.07.022

High efficiency non-fullerene organic solar cells without electron transporting Layers enabled by Lewis base anion doping

Rong Wang[a], Dongyang Zhang[a], Shenkun Xie[a], Jianqiu Wang[a], Zhong Zheng[b], Donghui Wei[c], Xiaobo Sun[a], Huiqiong Zhou[b,*], Yuan Zhang[a,*]

[a] School of Chemistry, Beijing Advanced Innovation Center for Biomedical Engineering, Beihang University, Beijing 100191, P. R. China
[b] Key Laboratory of Nanosystem and Hierachical Fabrication, CAS Center for Excellence in Nanoscience, National Center for Nanoscience and Technology, Beijing 100190, P. R. China
[c] The College of Chemistry and Molecular Engineering, Zhengzhou University, Zhengzhou, Henan Province 450001, P. R. China.

Abstract: Interfacial charge extraction and recombination play a critical role in photovoltaic characteristics of organic bulk heterojunction solar cells. Here we propose a methodology based on Lewis base *n*-doping with tetrabutylammonium acetate (TBAA) salts to boost charge extraction and resultant power conversion efficiencies (PCE) in OPVs with non-fullerene acceptors (NFA). Based on the PBDB-T:IT-M model system, we show that the TBAA doping via interfacial electron transfer is advantageous in maintaining the preferential intermolecular stacking and built-in potential necessitated for device operation compared to conventional bulk doping. Benefitting from the melioration of interfacial charge extraction and recombination, gains of photocurrent and fill factor are obtained in PBDB-T:IT-M solar cells. We found that the energy of charge transfer states after doping becomes slightly raised, which promotes the mitigation on radiative losses for open-circuit voltage. Furthermore, the described TBAA doping is found with the generality in modifying the device characteristics in non-fullerene based organic solar cells with different LUMO energies. Based on the PBDBT-2F:IT-4F BHJ blends, the solar cell doped with TBAA yields a PCE exceeding 13% without electron-transporting layer (ETL). This strategy allows for high efficiency ETL-free organic solar cells with potentials of reduced fabrication cost.

*Corresponding author email address:
yuanzhang@buaa.edu.cn (Y. Zhang) zhouhq@nanoctr.cn (H. Zhou)