Supporting information

Interface Engineering in Planar Perovskite Solar Cells: Energy Level Alignment, Perovskite Morphology Control and High Performance Achievement

Guang Yang, Changlei Wang, Hongwei Lei, Xiaolu Zheng, Pinli Qin, Liangbin Xiong, Xingzhong Zhao, Yanfa Yan and Guojia Fang

a Key Laboratory of Artificial Micro- and Nano-structures of Ministry of Education of China, School of Physics and Technology, Wuhan University, Wuhan 430072, People’s Republic of China.

*E-mail: gijfang@whu.edu.cn

b Department of Physics and Astronomy and Wright Center for Photovoltaics Innovation and Commercialization, the University of Toledo, Toledo, OH 43606, USA

*E-mail: yanfa.yan@utoledo.edu
Figure S1. XPS spectra and FTIR spectra of SnO$_2$ films with and without APTES SAM modification.
Figure S2. AFM images of SnO$_2$ electron selective layer deposited on the FTO glass with (c, d) and without (a, b) SAM modification.
Figure S3. The contact angle of water on the SnO$_2$ substrates (a), with APTES SAM (b) and UVO (c) treatment are 71.14°, 35.26° and 4.17°, respectively.
Figure S4. Work function for APTES SAM-treated SnO$_2$ surfaces as a function of APTES SAM treatment time.
Figure S5. (a) J-V curves for SnO$_2$ films with and without APTES SAM modification in the structure of FTO/SnO$_2$/Au. The thickness of SnO$_2$ film is about 50 nm. (b) Dark J-V curves for planar perovskite solar cells using SnO$_2$ (with and without APTES SAM modification) ESLs.
Figure S6. Long-term stability tests (~30% humidity) for 1000 h of an APTES SAM – treated device.
Figure S7. Top view SEM images of CH$_3$NH$_3$PbI$_3$ films with 5% Pb(SCN)$_2$ in the precursors deposited on SAM-modified SnO$_2$ ESL at different magnifications.
Figure S8. Photovoltaic parameters statistics of planar PSC with and without APTES SAM modification as collected from the same batch.