Supplementary Information

Temperature-Dependent Charge Transport in Solution-Processed Perovskite Solar Cells with Tunable Trap Concentration and Charge Recombination

Xuning Zhang, Shiqing Bi, Jiyu Zhou, Shuai You, Huiqiong Zhou*, Yuan Zhang*, and Zhiyong Tang

X. Zhang, J. Zhou, Prof. Y. Zhang
Heeger Beijing Research and Development Center, School of Chemistry
Beihang University, Beijing 100191, P. R. China
Email: yuanzhang@buaa.edu.cn

S. You, Dr. S. Bi, Prof. H. Zhou, Prof. Z. Tang,
CAS Key Laboratory of Nanosystem and Hierarchical Fabrication, CAS Center for Excellence in Nanoscience
National Center for Nanoscience and Technology, Beijing 100190, P. R. China
Email: zhouhq@nanoctr.cn

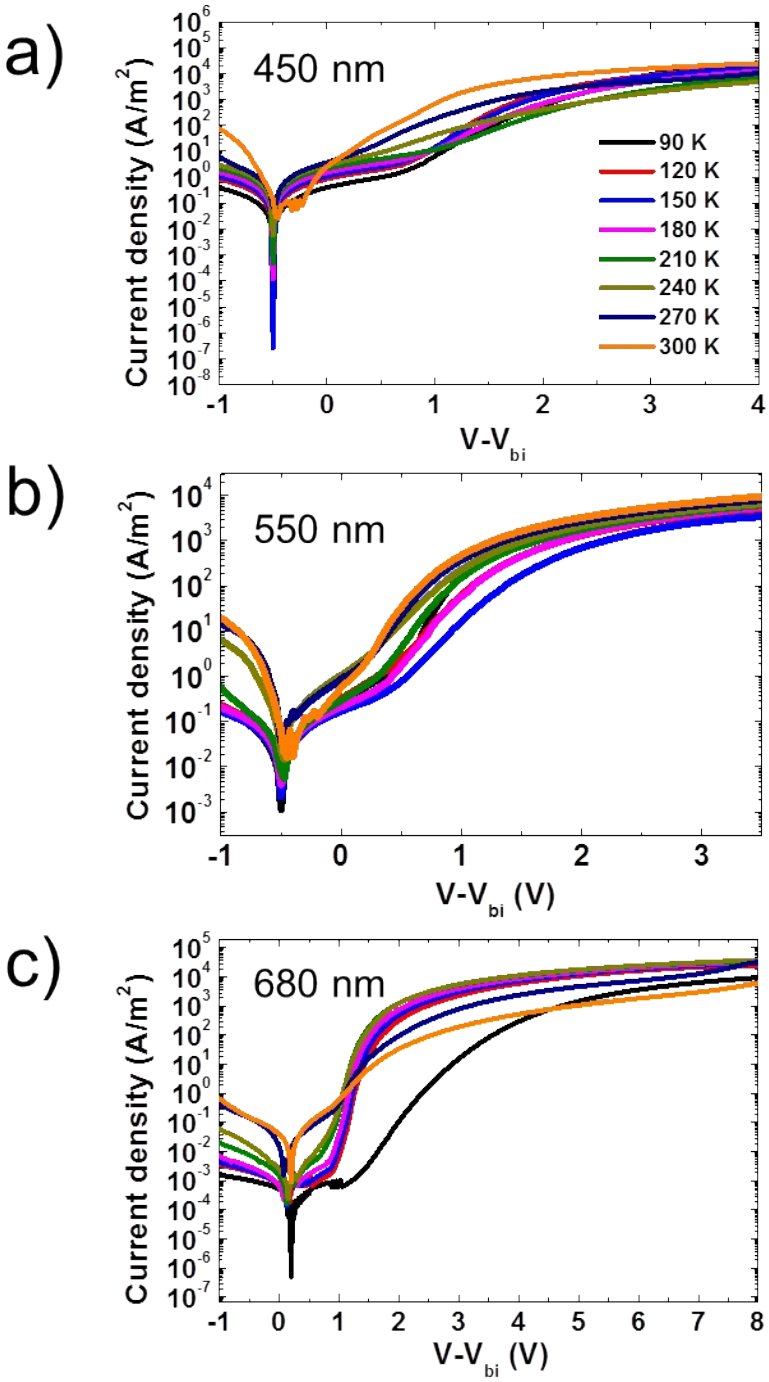

Figure S1. (a)-(c) Temperature-dependent current density versus voltage characteristics in semi-logarithm scale of $MAPbI_3$ hole-only devices with various *L* scanned in the downward direction.

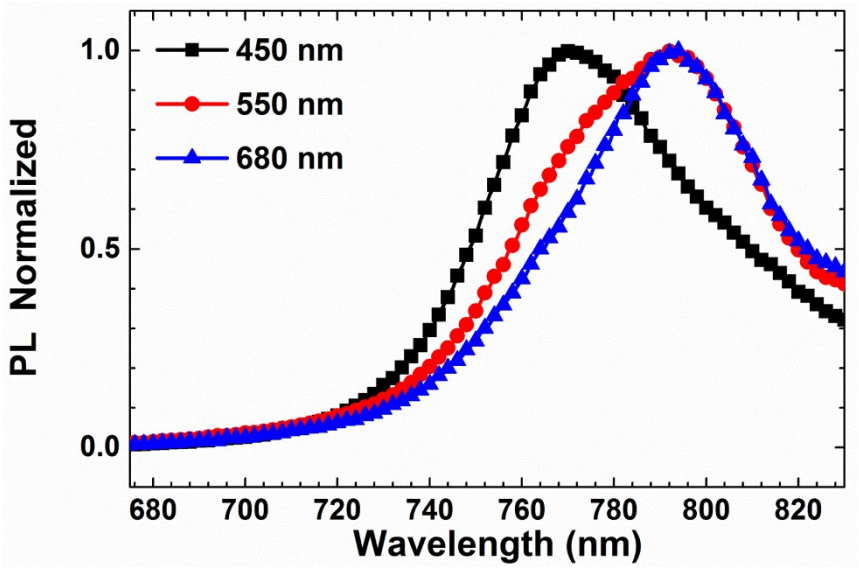

Figure S2. Steady-state photoluminescence spectroscopy of $MAPbI_3$ films with different *L*.

Table S1. $MAPbI_3$ solar cell parameters measured under standard AM 1.5 G with various film thicknesses *L* controlled by solution concentration. The data were collected in the downward scan (bias from positive to negative).

L (nm)	V_{oc} (V)	J_{sc} (mA/cm^2)	FF	PCE (%)
450	0.98	17.47	0.72	12.3
550	0.92	14.20	0.77	10.0
680	0.88	11.94	0.78	8.2

Table S2. Fitting parameters using bi-exponential model for photoluminescence decay kinetics measured on $MAPbI_3$ films with various *L*.

L (nm)	τ_1(s)	A_1	τ_2 (s)	A_2
450	4.42×10^{-8}	20.18%	3.97×10^{-7}	79.82%
550	5.14×10^{-8}	16.68%	4.02×10^{-7}	83.32%
680	5.50×10^{-8}	14.73%	4.45×10^{-7}	85.27%