Supporting Information

Room-Temperature Water-Vapor Annealing for High-Performance Planar Perovskite Solar Cell

Binbin Wang,[ab] Zhi-guo Zhang,[a] Senyun Ye,[c] Haixia Rao,[c] Zuqiang Bian,[c] Chunhui Huang [c] and Yongfang Li*[ad]*

[a] *Beijing National Laboratory for Molecular Sciences, CAS Key Laboratory of Organic Solids, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China*
E-mail: liyf@iccas.ac.cn; zgzhangwhu@iccas.ac.cn
[b] *School of Materials Science and Engineering, Henan Polytechnic University, Jiaozuo, Henan 454000, China*
[c] *Beijing National Laboratory for Molecular Sciences, State Key Laboratory of Rare Earth Materials and Applications, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China*
[d] *Laboratory of Advanced Optoelectronic Materials, College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou, Jiangsu 215123, China*

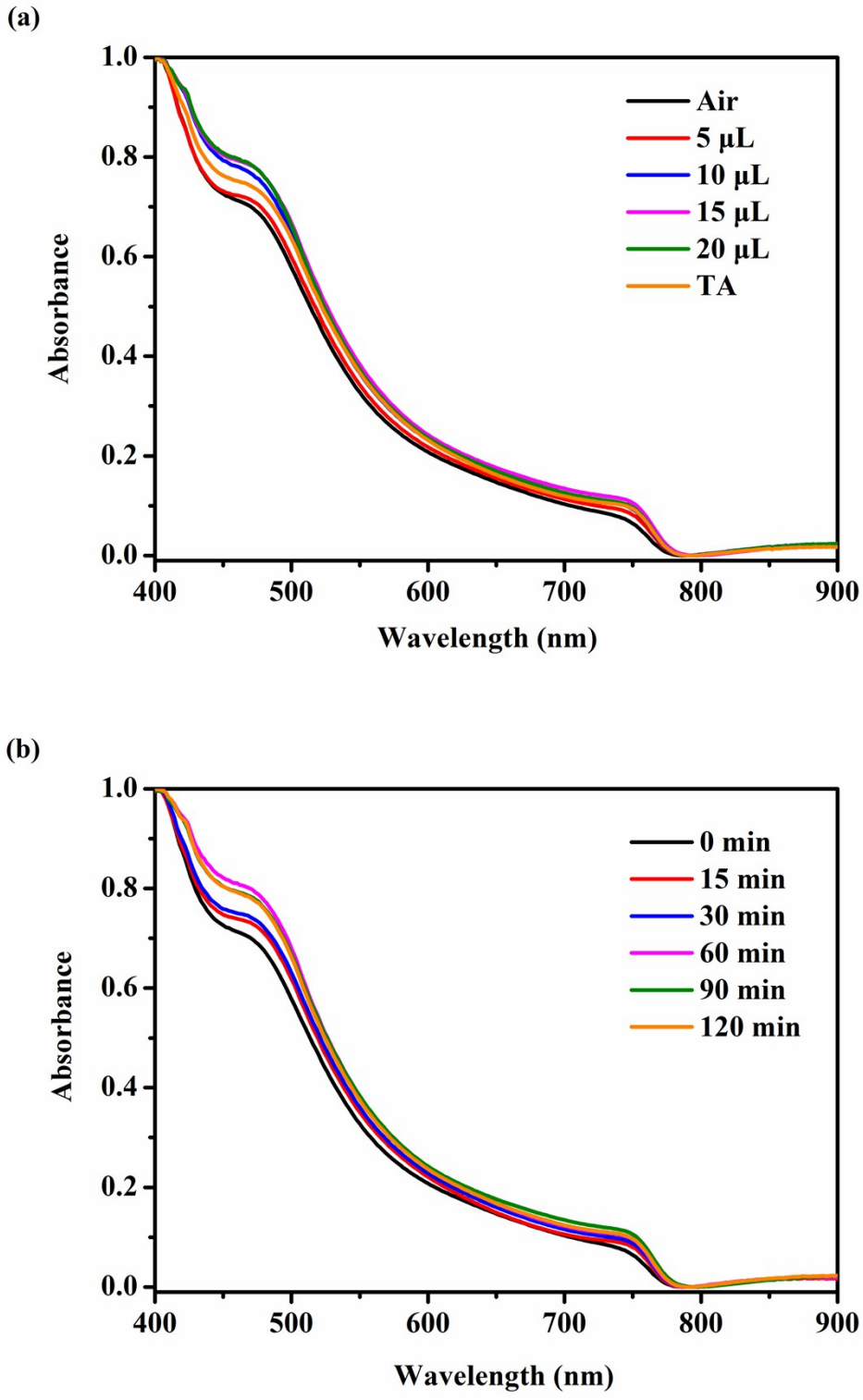

Figure S1. (a) Normalized UV-vis absorption spectra of the perovskite films treated by Air, TA and WVA with different volume of water for 60 minutes.(b) Normalized UV-vis absorption spectra of the perovskite films treated by WVA in RH% = 36~43% for different times.

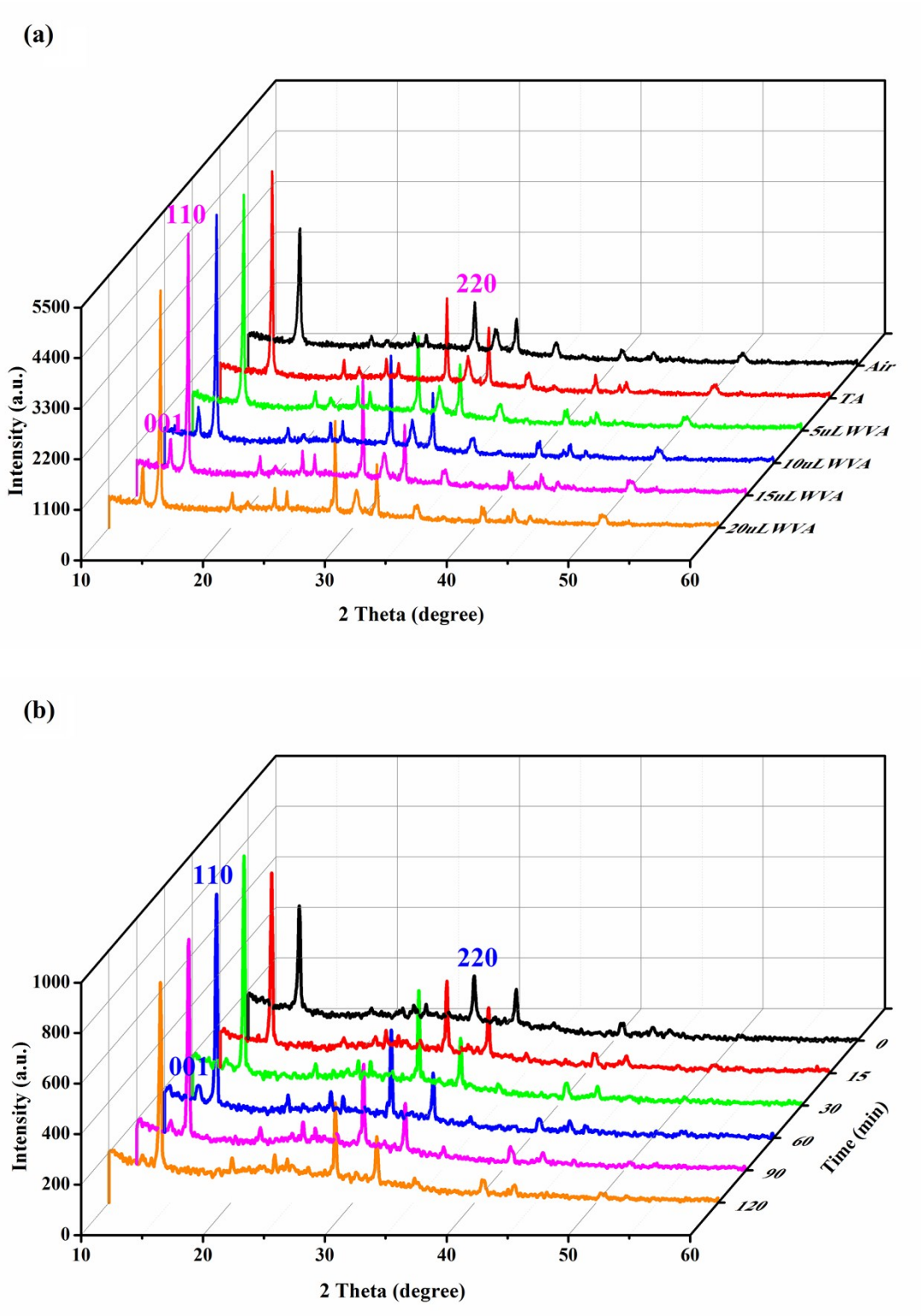

Figure S2. (a) XRD patterns of the perovskite films treated by Air, TA and WVA with different water volume for 60 minutes.(b) XRD patterns of the perovskite films treated by WVA in RH% = 36~43% for different times.

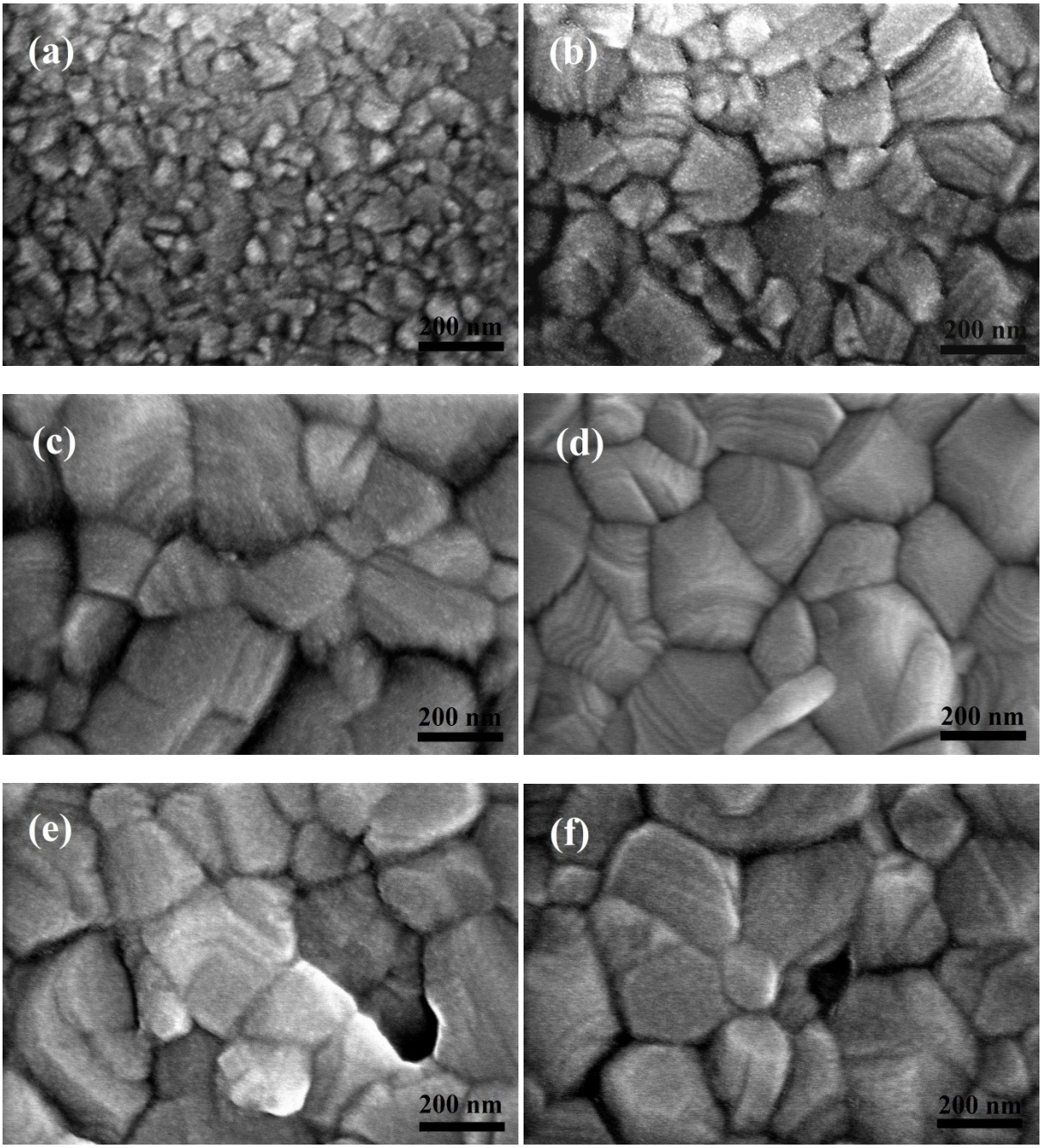

Figure S3. SEM images of the perovskite films treated by WVA in RH% = 36~43% for (a) 0 min, (b)15 min, (c) 30 min, (d) 60 min, (e) 90 min, (f) 120 min, respectively.

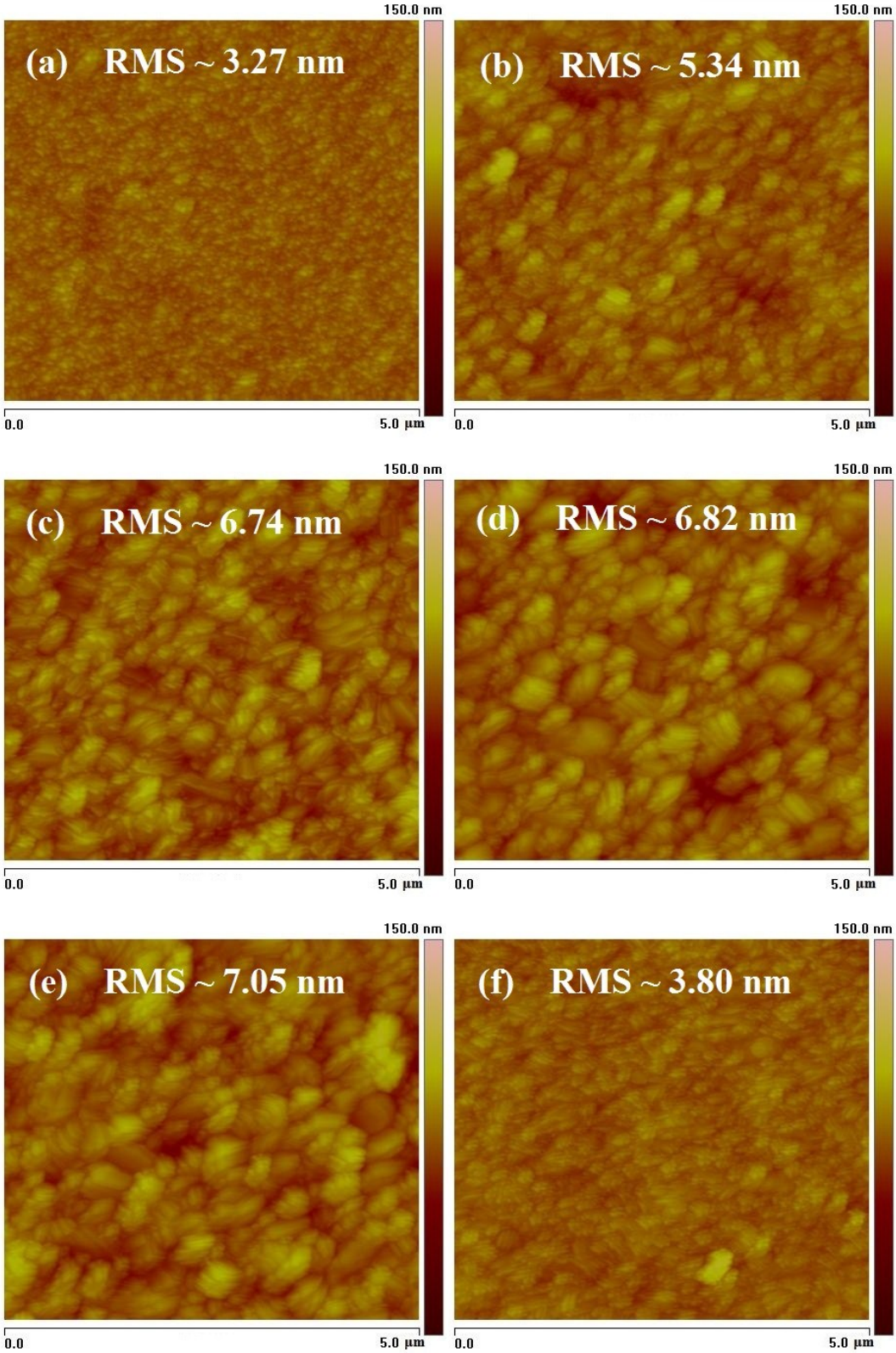

Figure S4. AFM images of the perovskite films treated by Air (a), TA (f) and WVA with 5 µL (b), 10 µL (c), 15 µL (d), 20 µL water (e) for 60 min.

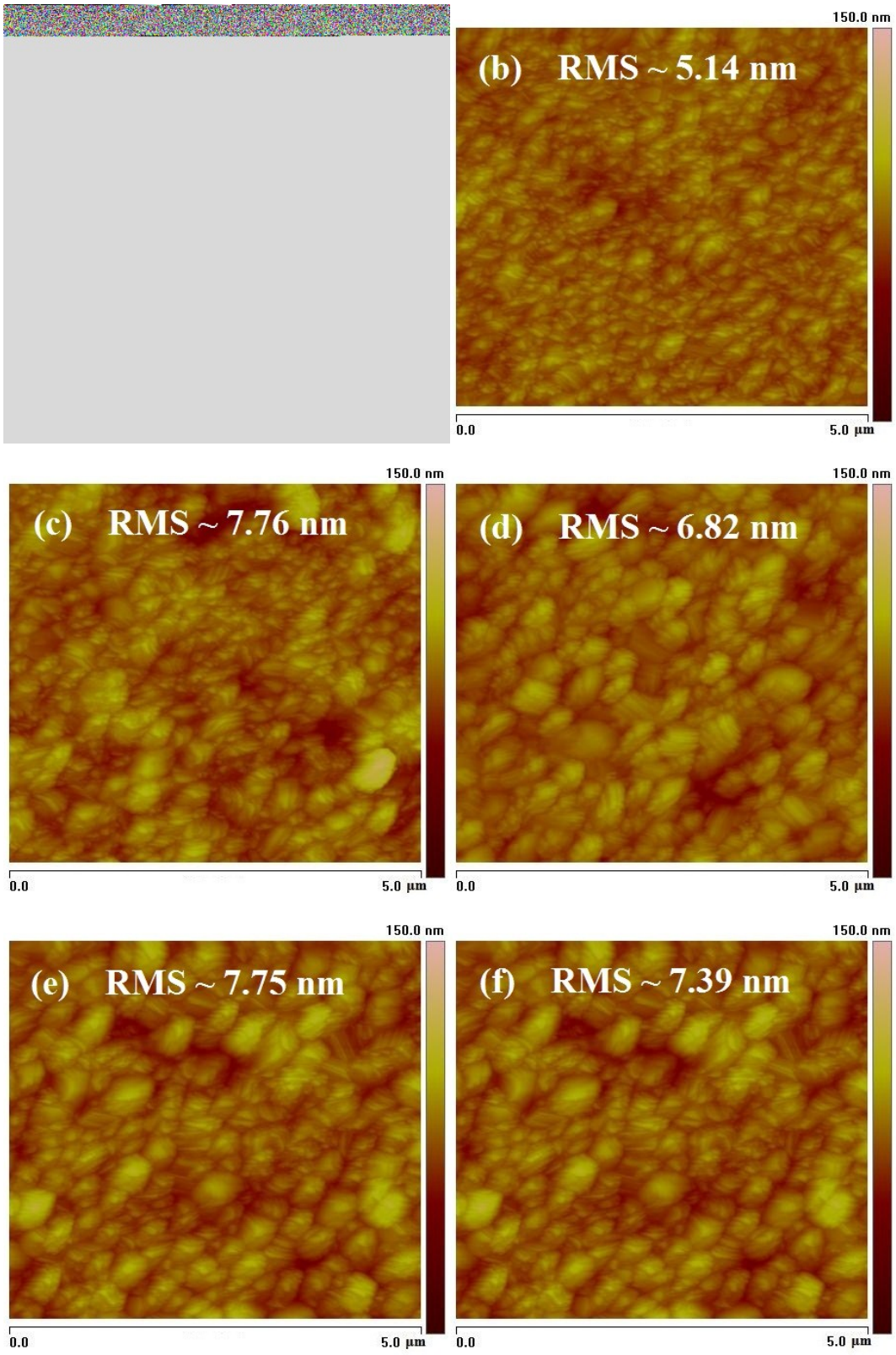

Figure S5. AFM images of the perovskite films treated by WVA in RH% = 36~43% for (a) 0 min, (b)15 min, (c) 30 min, (d) 60 min, (e) 90 min, (f) 120 min, respectively.

Table S1 Photovoltaic properties of the pero-SCs treated by Air, TA and WVA with 5 μL, 10 μL, 15 μL, 20 μL water for 60 minutes, under the illumination of AM1.5G, 100 mW cm^{-2}.

		V_{oc}(V)	J_{sc}(mA cm^{-2})	*FF*(%)	*PCE* (%)
	Air	**0.93**	**7.67**	**79.14**	**5.67**
WVA	**5 μL**	**0.98**	**15.62**	**71.20**	**10.86**
	10 μL	**1.00**	**19.21**	**75.43**	**14.48**
	15 μL	**0.99**	**20.83**	**78.74**	**16.24**
	20 μL	**0.94**	**19.84**	**77.47**	**14.43**
	TA	**0.87**	**19.38**	**76.86**	**12.88**

Table S2. Photovoltaic properties of the pero-SCs treated by WVA in RH% = 36~43% for 0, 15, 30, 60, 90, 120 minutes, respectively, under the illumination of AM1.5G, 100 mW cm^{-2}.

Time	V_{oc}(V)	J_{sc}(mA cm^{-2})	*FF*(%)	*PCE* (%)
0 min	**0.93**	**7.67**	**79.14**	**5.67**
15 min	**1.01**	**14.06**	**71.40**	**10.13**
30 min	**0.99**	**19.47**	**71.77**	**13.89**
60 min	**1.00**	**20.91**	**78.75**	**16.39**
90 min	**0.93**	**19.94**	**80.08**	**14.79**
120 min	**0.94**	**18.07**	**73.05**	**12.41**

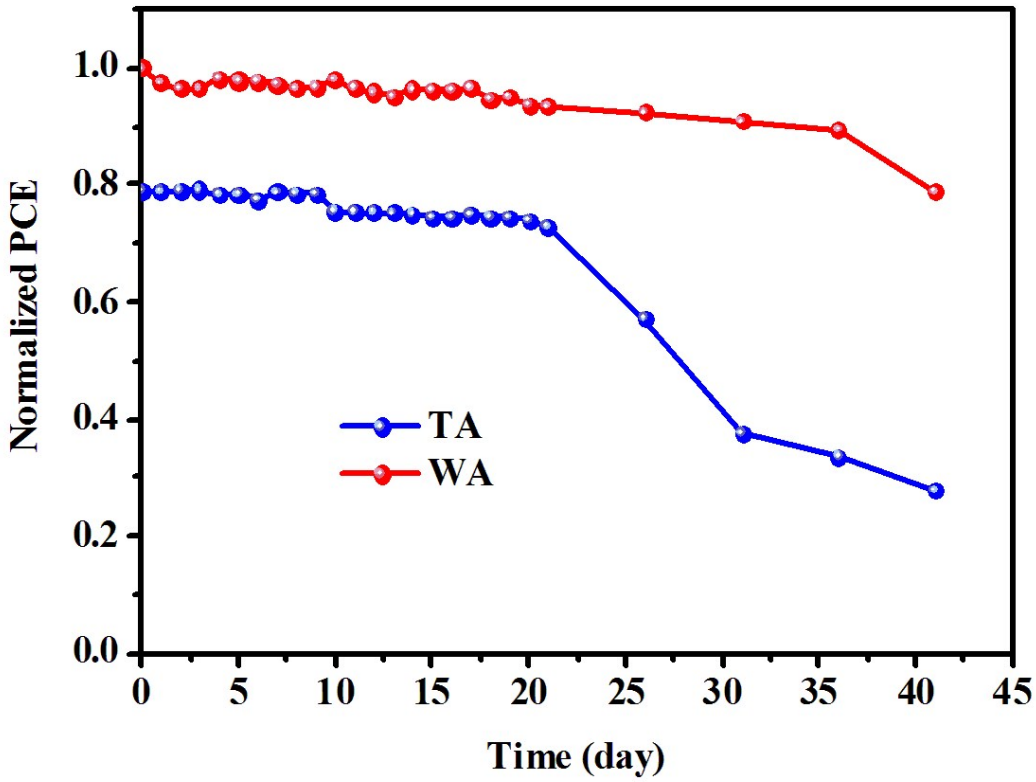

Figure S6. Long-term stability test of the pero-SCs treated by TA and WVA in RH% = 36~43% for 60 minutes (in a glove box).