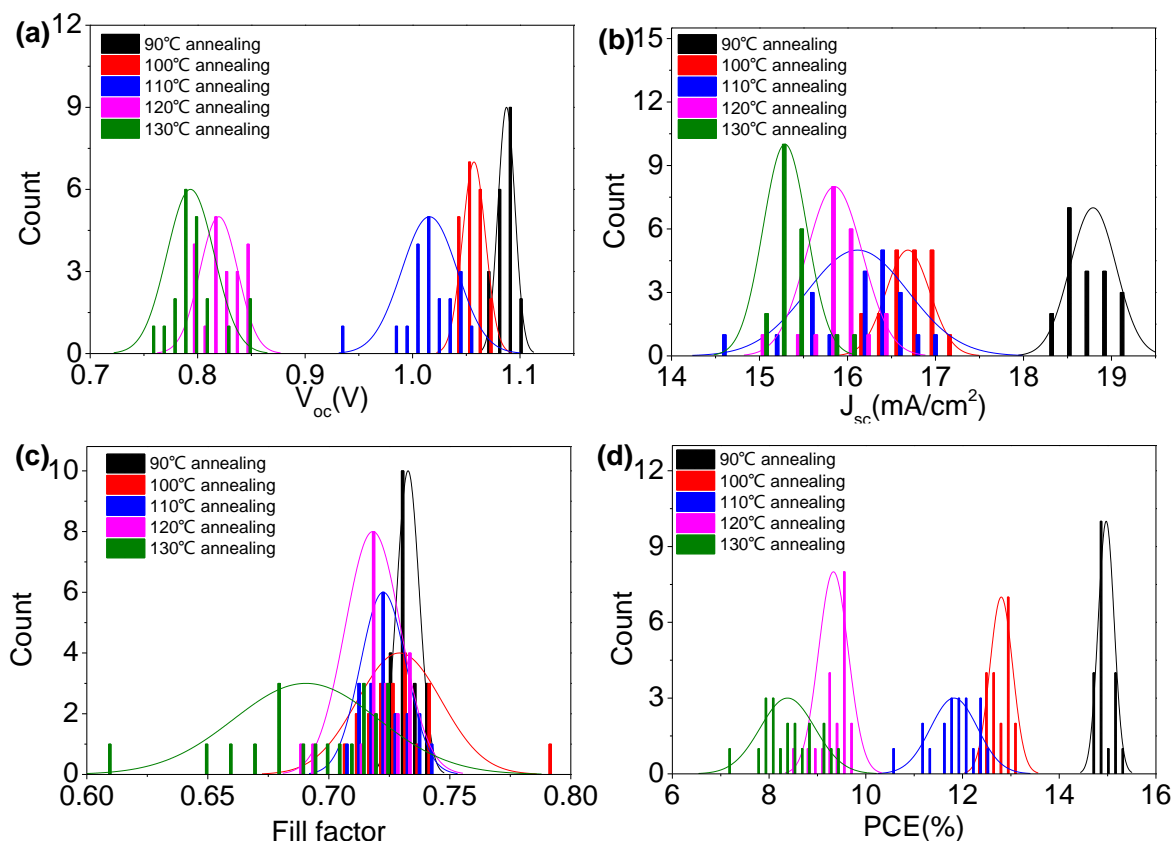


## Supporting Information

### Exploring the role of spin-triplets and trap states in photovoltaic processes of perovskite solar cells

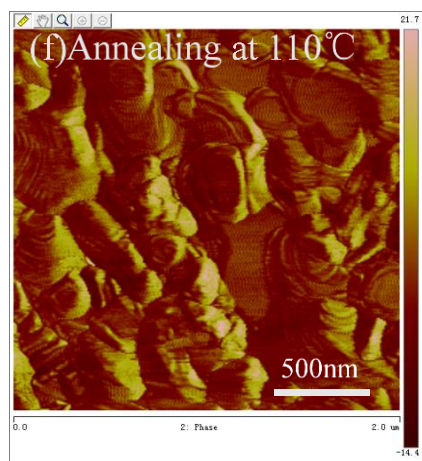
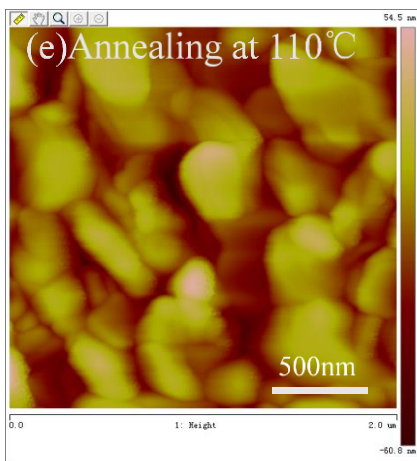
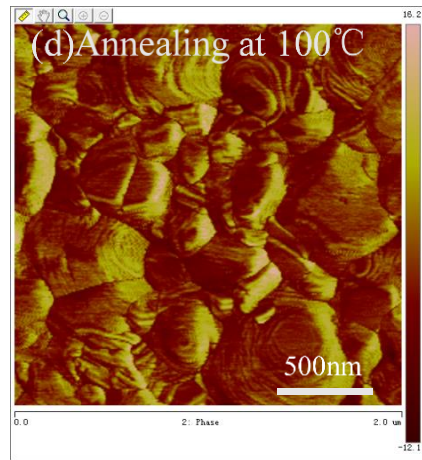
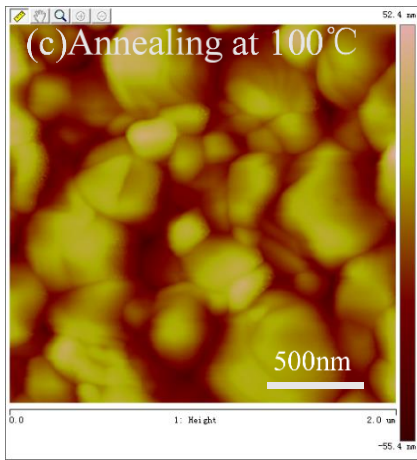
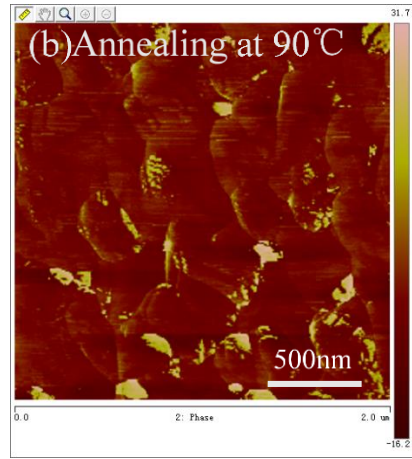
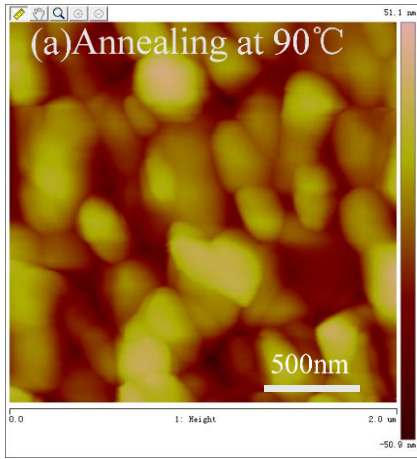
Kai Lu, Chen Zhao, Luan Lin, Jia-Shun Duan, Yu-Lin Xie, Ming Shao\*, and Bin Hu\*

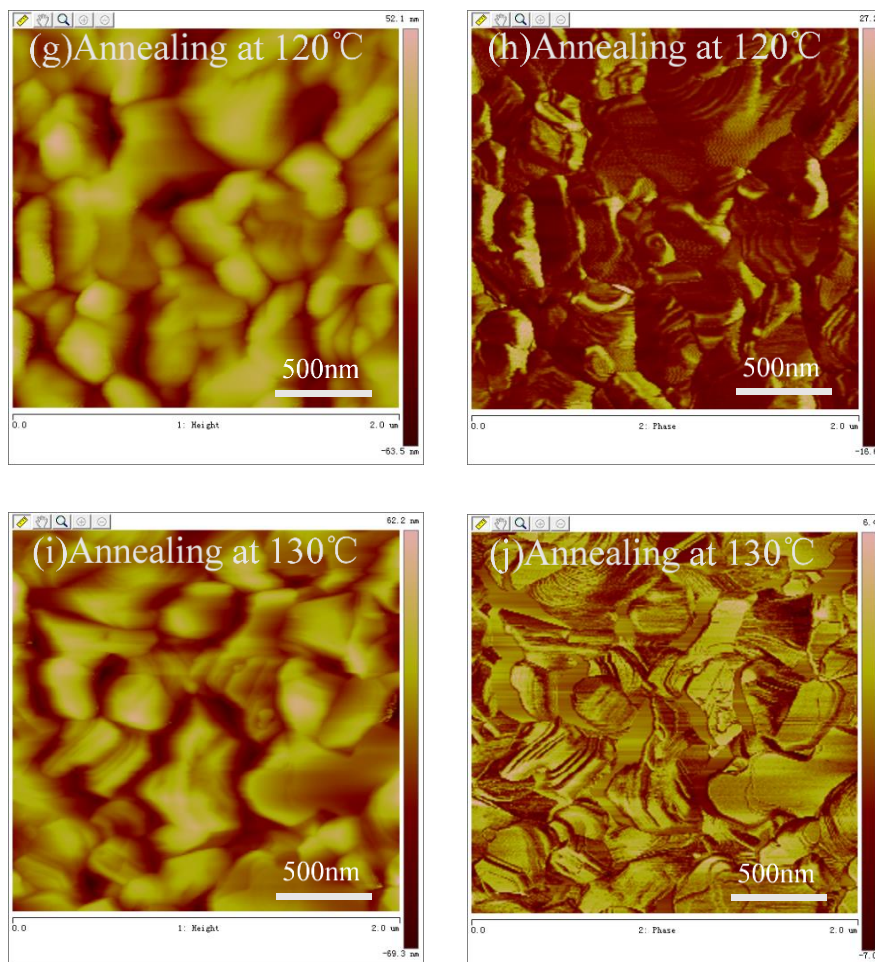


**Figure. S1** Histogram analyses of (a) $V_{oc}$ , (b) $J_{sc}$ , (c)Fill Factor and (d)PCE of 20 devices for each annealing temperature at 90°C, 100°C, 110°C, 120°C and 130°C, respectively.

**Table. S1** Average value of the photovoltaic parameters for the PSCs annealing at different temperature.

Annealing temperature	Average $V_{oc}$ (V)	Average $J_{sc}$ (mA/cm <sup>2</sup> )	Average FF	Average PCE(%)
90°C	1.09±0.008	18.79±0.262	0.73±0.005	14.97±0.165
100°C	1.06±0.011	16.67±0.250	0.73±0.017	12.80±0.236
110°C	1.02±0.026	16.11±0.577	0.72±0.009	11.83±0.487
120°C	0.82±0.018	15.85±0.317	0.72±0.011	9.33±0.309
130°C	0.79±0.022	15.29±0.249	0.69±0.030	8.38±0.567





**Figure. S2** Atomic force microscopy(AFM) 2D topography(a, c, e, g, i) and phase(b, d, f, h, j) images of the perovskite films annealing at 90°C,100°C,110°C,120°C,130°C.