Electronic Supplementary Information

Efficient perovskite solar cell fabricated in ambient air using one-step spin-coating

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1. Annealing process

The equipment for vacuum annealing method was a vacuum oven (DZF-6020), as showed in Fig. S1. Both the vacuum oven and hot plate were heated to 95℃ before annealing. After annealing, both the films annealed in vacuum and in air were cooled to room temperature naturally. The cooling times for the film annealed in air and in vacuum were 70 and 350 minutes respectively.

Figure S1. The vacuum oven for vacuum annealing.

2. J-V hysteresis curves

The J-V hysteresis curves of devices fabricated with different annealing method are shown in Fig. S2. The J-V curves were measured in reverse (from 1.2 to -1.2 V) or forward (from -1.2 to 1.2 V) scan (using Keithley 2400 with a voltage step of 10 mV and 0 ms delay time). The best PCE of devices annealed in vacuum (12.98%) or in air (9.2%) are obtained at reverse scan. While, the PCE decreases are observed when forward scanning the devices.

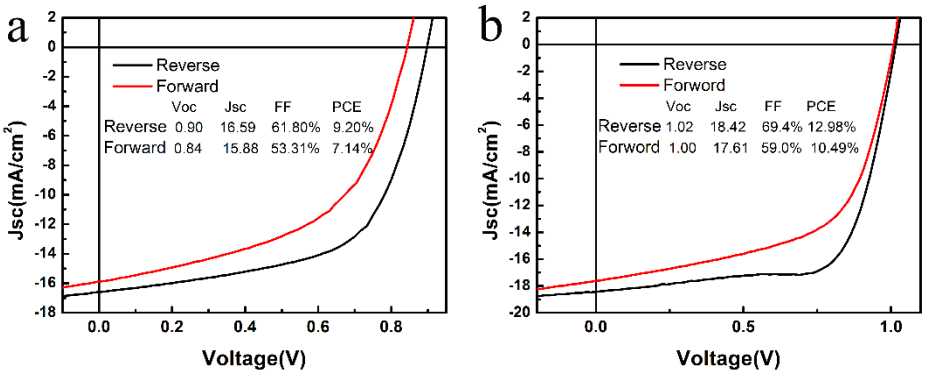

Figure S2. Hysteresis J-V measurements scanned in forward (red) and reverse (black) directions for devices annealed in air (a) and vacuum (b).

3. The element analysis

The element analysis of films annealed with different methods were characterized by EDS and XPS (ESCALAB 250Xi). From the EDS characterization (Fig. S3), the ration I:Pb in the films are 2.70±0.05 (annealed in vacuum, Fig. S3 a) and 2.77±0.07 (annealed in air, Fig. S3 b) respectively. The amount of residual chloride in perovskite films annealed in vacuum is higher than that in films annealed in air, which is consistent with characterization of XPS (Fig. S4).

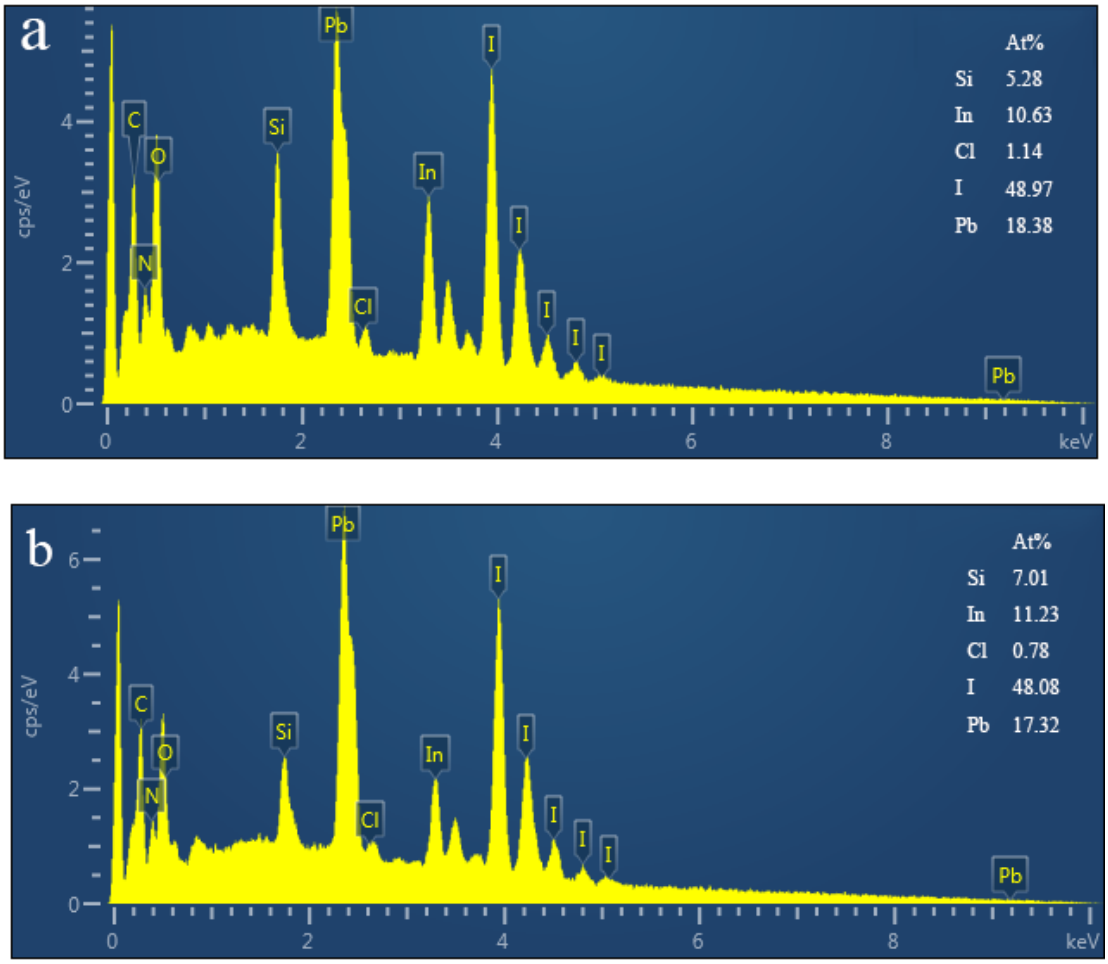

Figure S3. The characterization of EDS for perovskite films annealed in vacuum (a) and air (b).

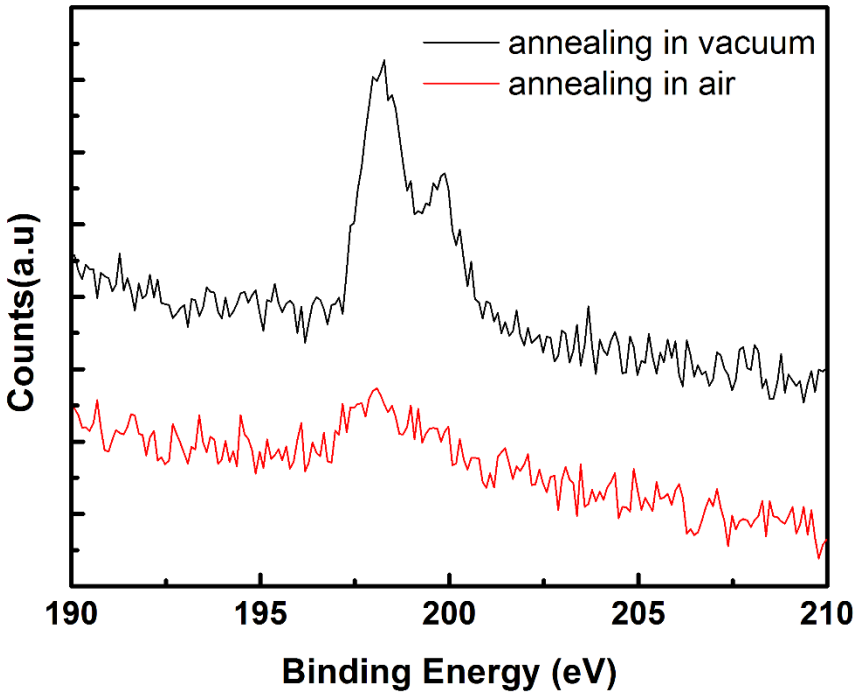

Figure S4. Cl2p core level XPS spectra of the perovskite films.