

## **Supplementary Materials**

### **Stepwise Optimization of Antisolvent Dripping and Annealing Times for High-Efficiency Inverted Perovskite Solar Cells**

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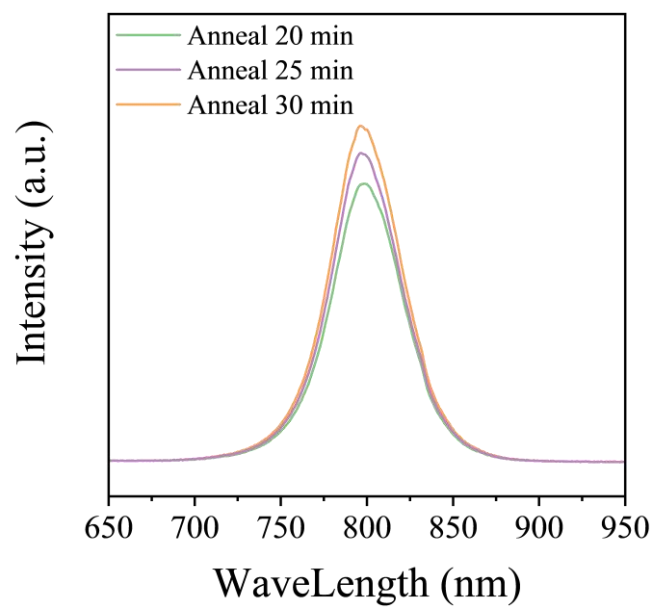


**Figure S1.** PL spectra of perovskite films prepared at different annealing times of 20, 25, and 30 min.

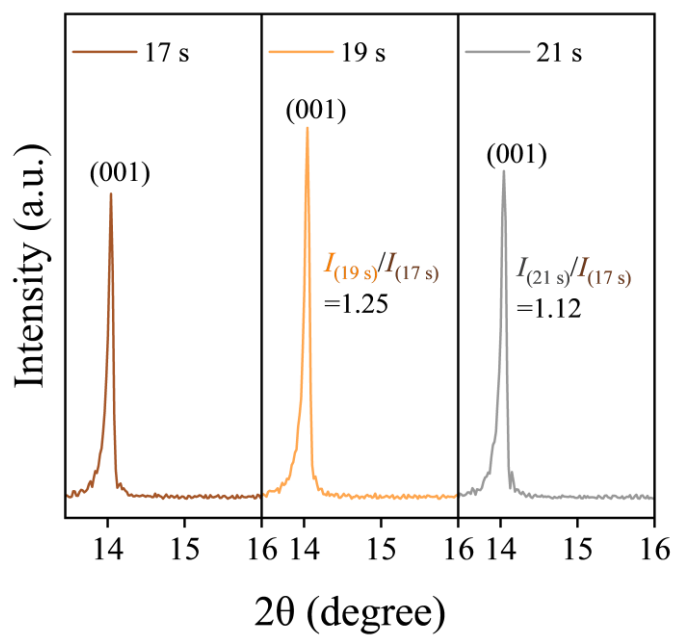


**Figure S2.** XRD (001) diffraction patterns of perovskite films prepared at antisolvent dripping times of 17, 19, and 21 s.

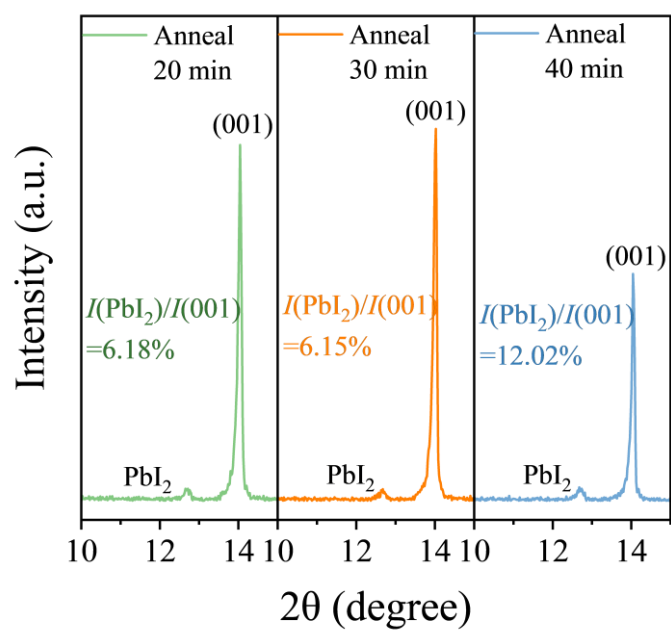


**Figure S3.** XRD spectra of perovskite films prepared at different annealing times of 20, 30, and 40 min.

**Table S1.** Statistical summary of photovoltaic parameters of 14 independent PSCs with different annealing times.

| Anneal time (min) | $J_{SC}$ (mA/cm <sup>2</sup> ) | $V_{OC}$ (V)     | FF (%)           | PCE (%)           |
|-------------------|--------------------------------|------------------|------------------|-------------------|
| 20                | 25.25±0.52                     | 1.12±0.03        | 77.43±2.52       | 21.81±0.96        |
| <b>30</b>         | <b>25.56±0.38</b>              | <b>1.15±0.01</b> | <b>82.16±1.5</b> | <b>24.16±0.33</b> |
| 40                | 25.39±0.42                     | 1.14±0.01        | 80.13±1.61       | 23.25±0.35        |