# Supporting Information

## Enhancing Perovskite Solar Cell Performance and Stability by Doping Barium in Methylammonium Lead Halide

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**Table S1**. The stoichiometric ratio of elements as determined by EDS for pristine perovskite and 3.0 mol% Ba-doped perovskite film.
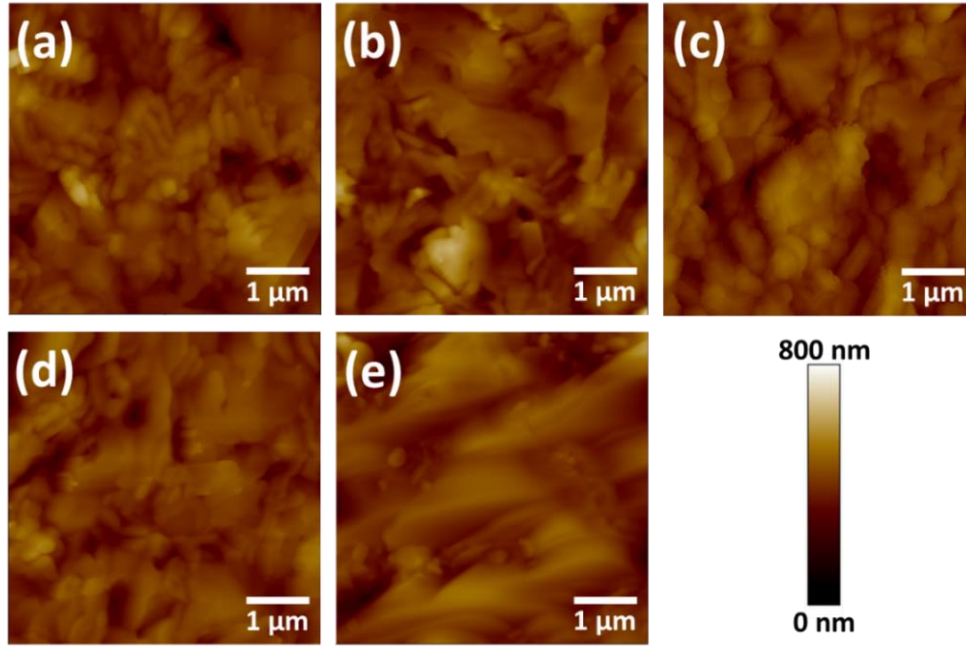
| Perovskite | Pb (at.%) | Ba (at.%) | Ba/Pb+Ba (%) | I (at.%) | Cl (at.%) | I/I+Cl (%) |
|---|---|---|---|---|---|---|
| $CH_3NH_3PbI_{3-y}Cl_y$ | 25.46 | - | - | 67.96 | 6.58 | 91.17 |
| $CH_3NH_3Ba_{0.03}Pb_{0.97}I_{3-y}Cl_y$ | 23.85 | 0.71 | 2.89 | 69.15 | 6.29 | 91.66 |
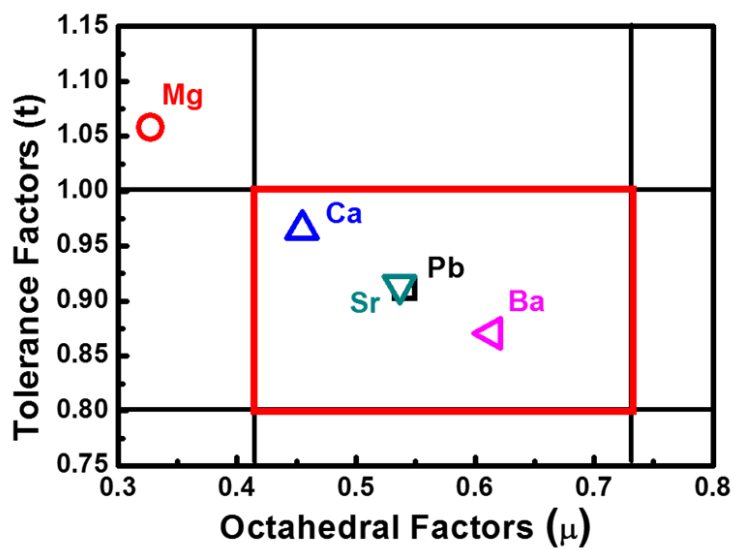
**Figure S1**. Plot of tolerance factors versus octahedral factors of $CH_3NH_3MI_3$ (M=Mg, Ca, Sr and Ba).
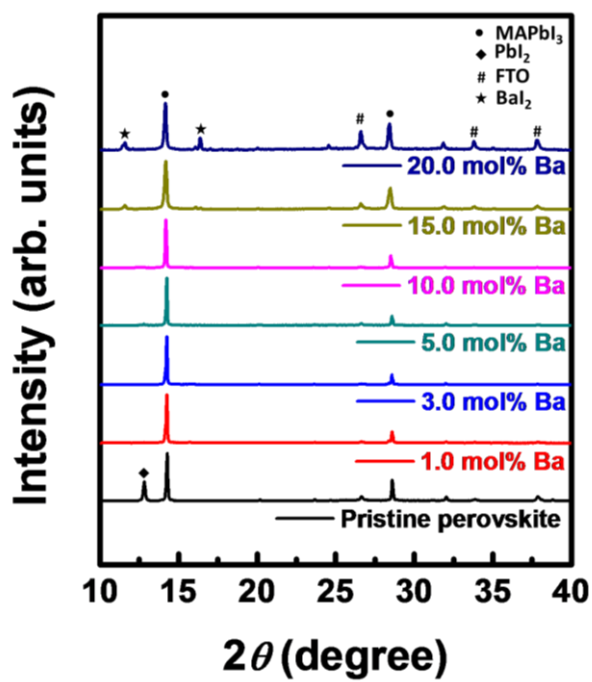
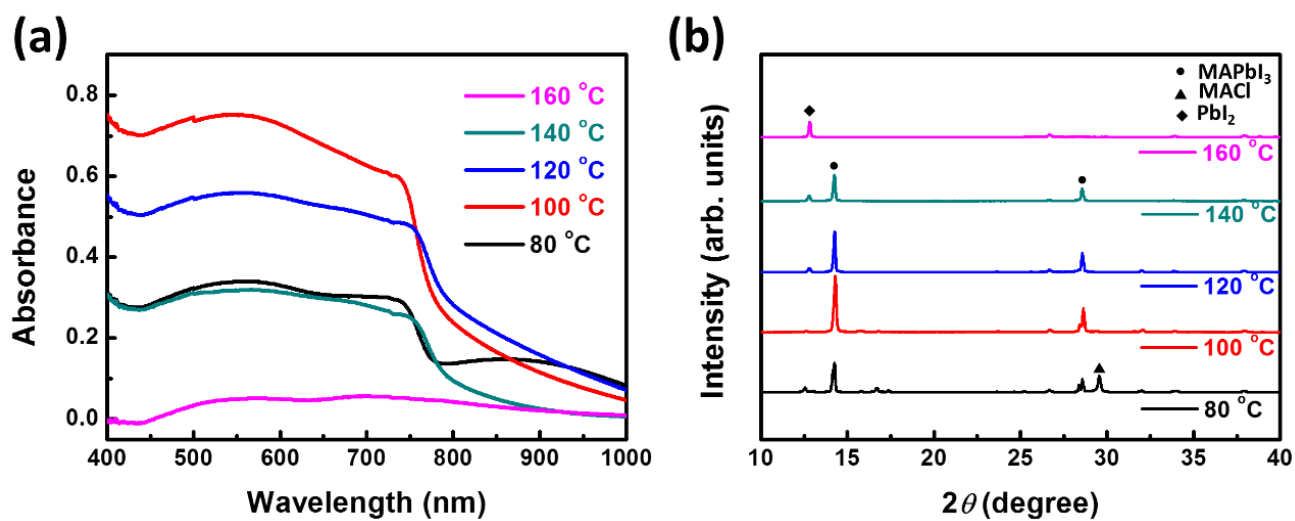

**Figure S2**. XRD patterns of perovskite films with different $Ba^{2+}$ doping concentrations.

**Figure S3**. AFM images of **(a)** the pristine perovskite film, **(b)** 1.0 mol%, **(c)** 3.0 mol%, **(d)** 5.0 mol%, and **(e)** 10.0 mol% $Ba^{2+}$-doped perovskite films.
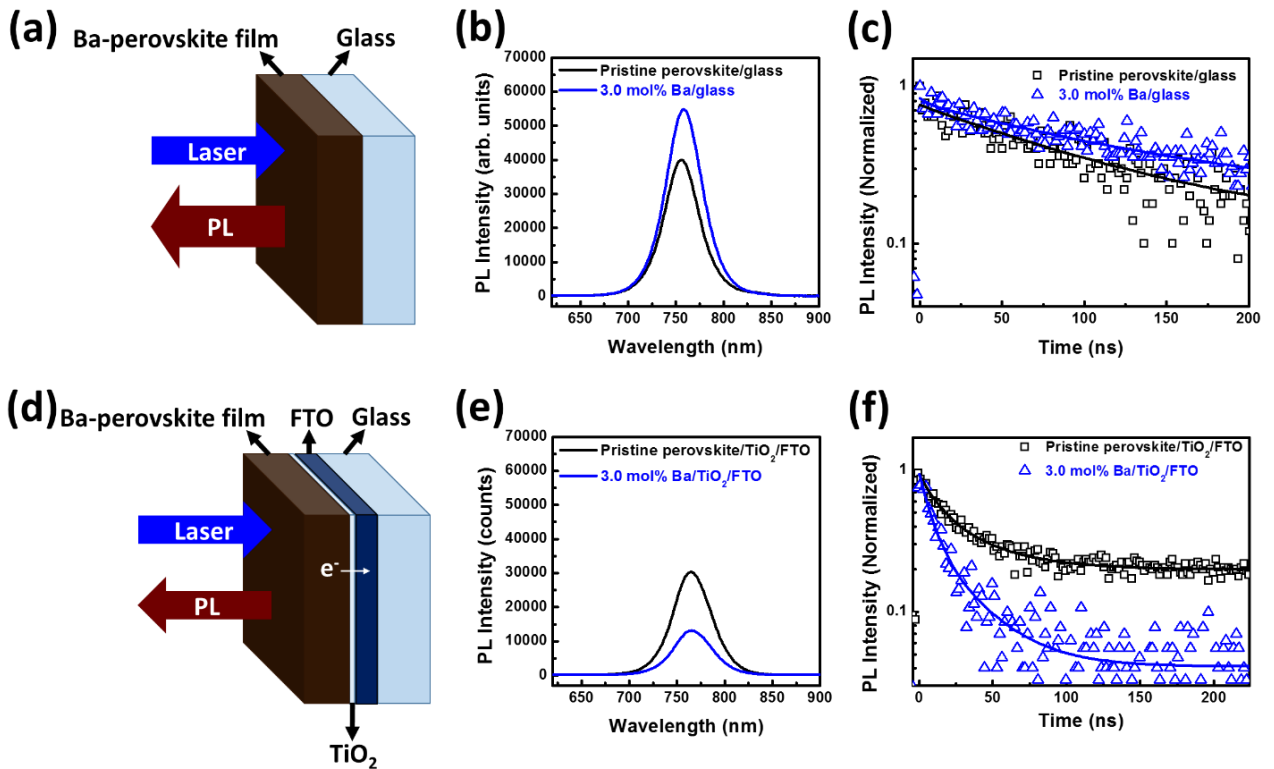


**Figure S4**. **(a, d)** The schematic diagram, **(b, e)** photoluminescence spectra and **(c, f)** time-resolved photoluminescence decays of pristine perovskite and 3.0 mol% Ba-doped perovskite film on **(a, b, c)** the glass substrate and **(d, e, f)** the $TiO_2$/FTO glass substrate.

**Figure S5**. **(a)** The absorption spectra and **(b)** XRD patterns of the 3.0 mol% Ba-doped perovskite film with different annealing temperatures.