

Supporting Information

Ultrathin and compact electron transport layer made from novel water-dispersed Fe₃O₄ nanoparticles to accomplish UV-stable perovskite solar cells

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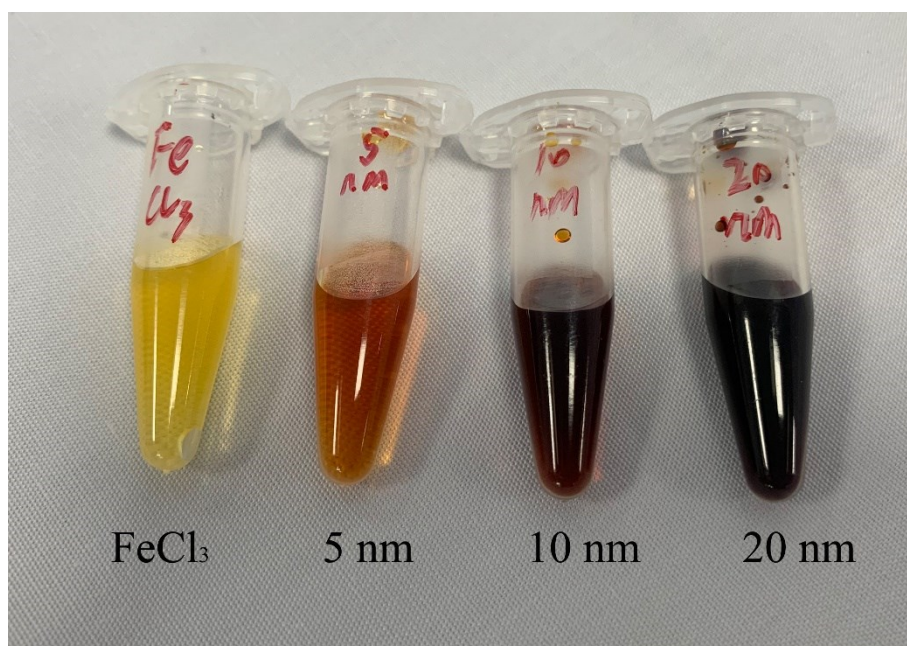


Figure S1 The photo of different solution (taken in our lab).

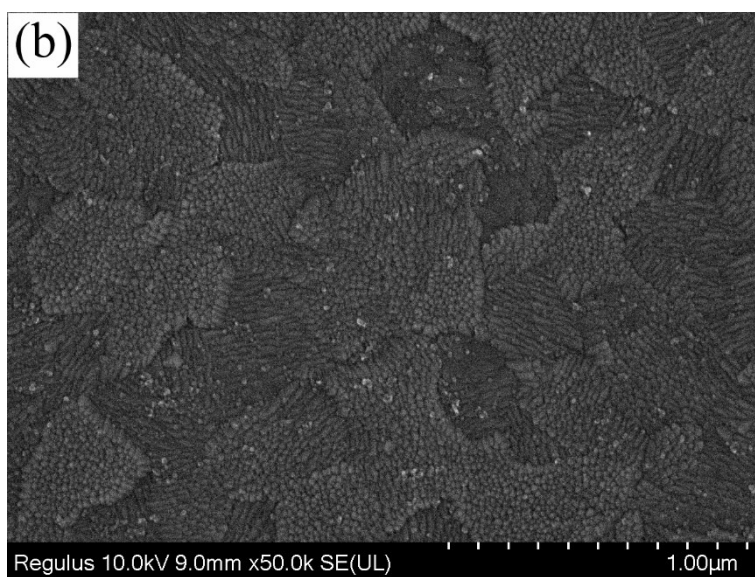
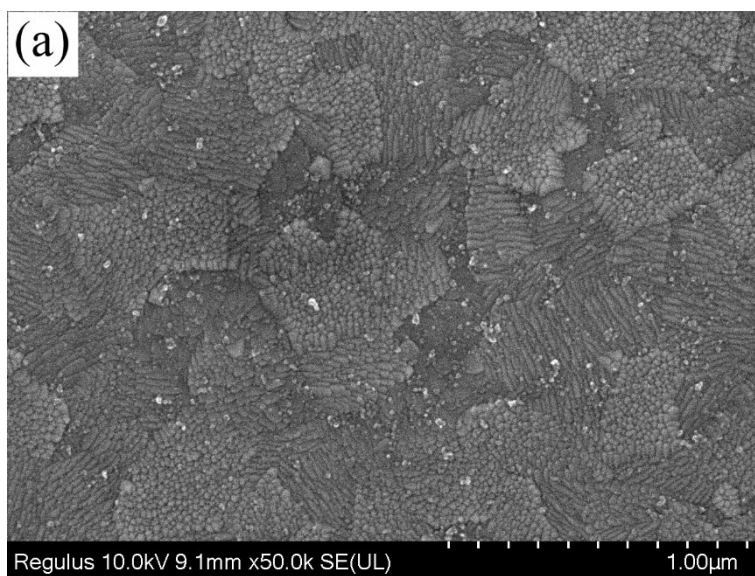


Figure S2 SEM images of a) 5nm and b) 20 nm samples.

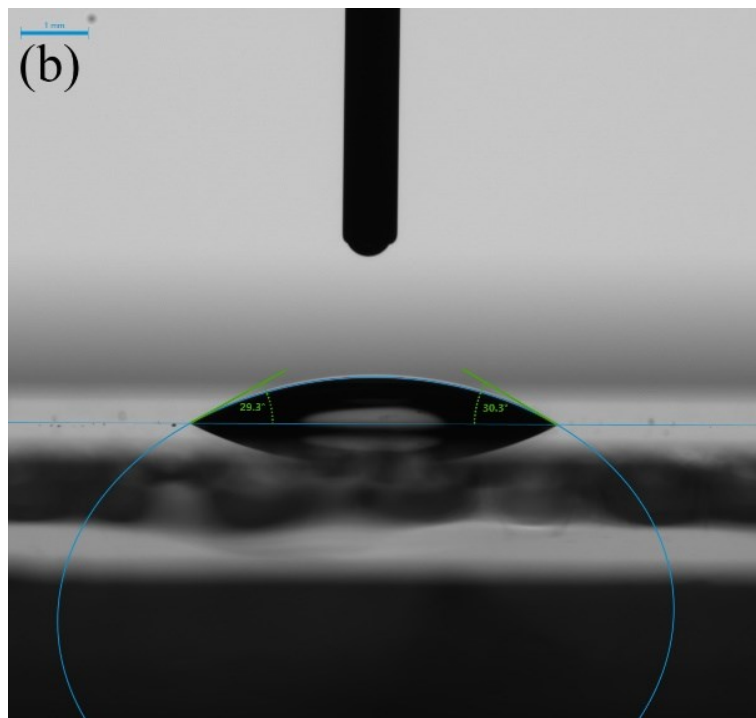
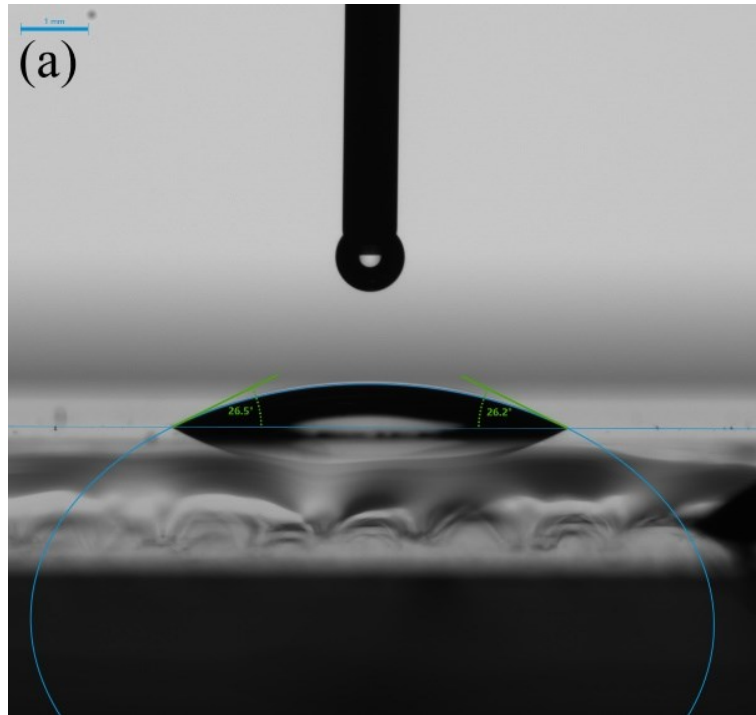


Figure S3 Contact angle test of a) FeCl_3 and b) Fe_3O_4 prepared Fe_2O_3 film.

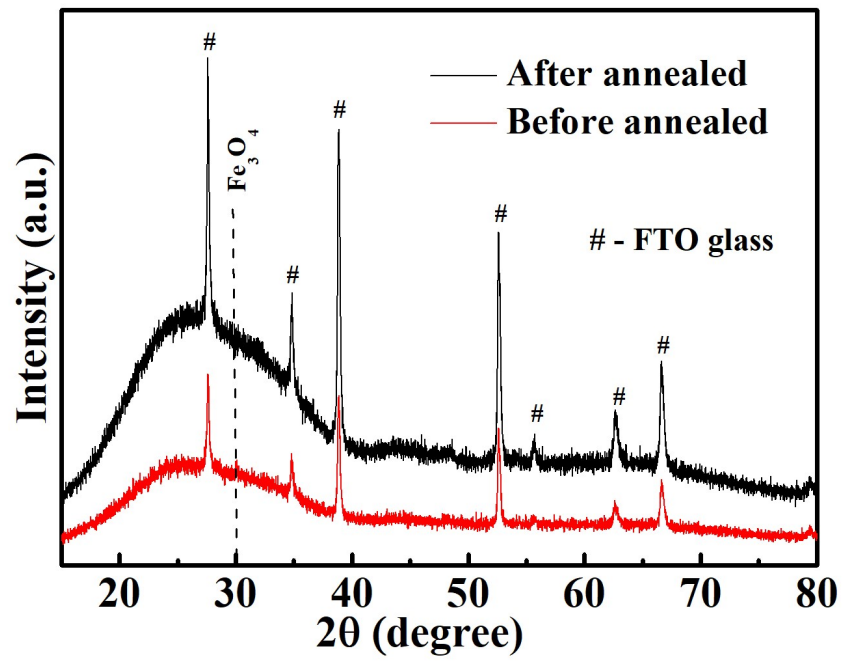


Figure S4 XRD pattern of Fe₂O₃ film before and after annealed.

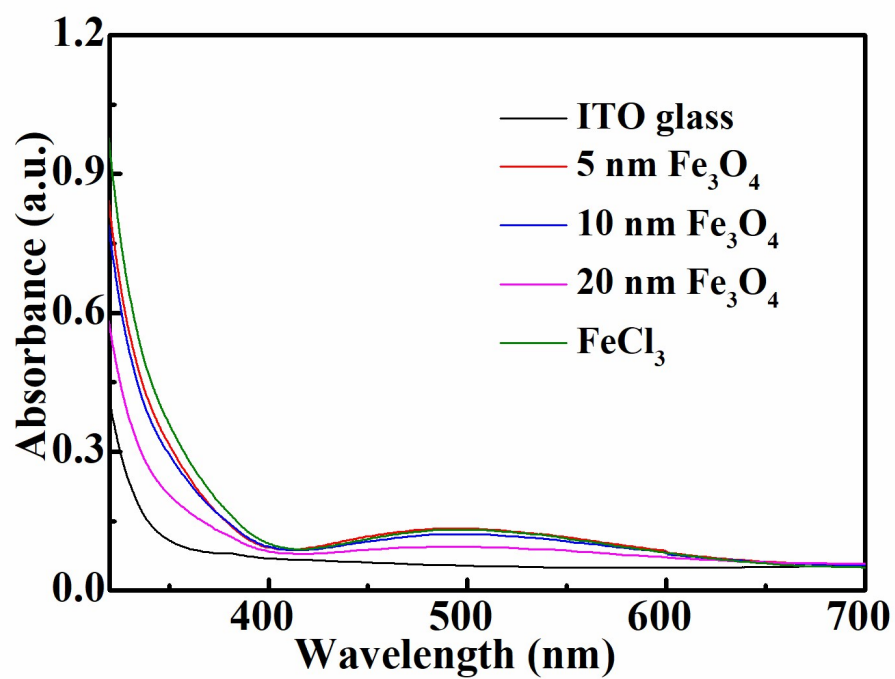


Figure S5 Absorbance measurement of ITO and Fe₂O₃ film with different method.

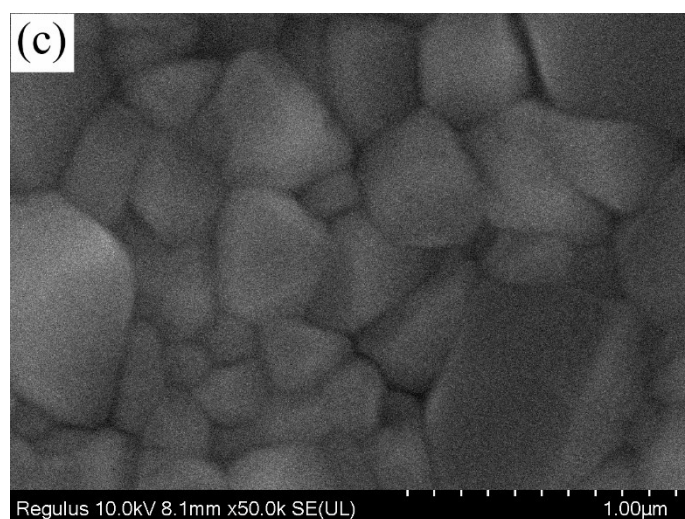
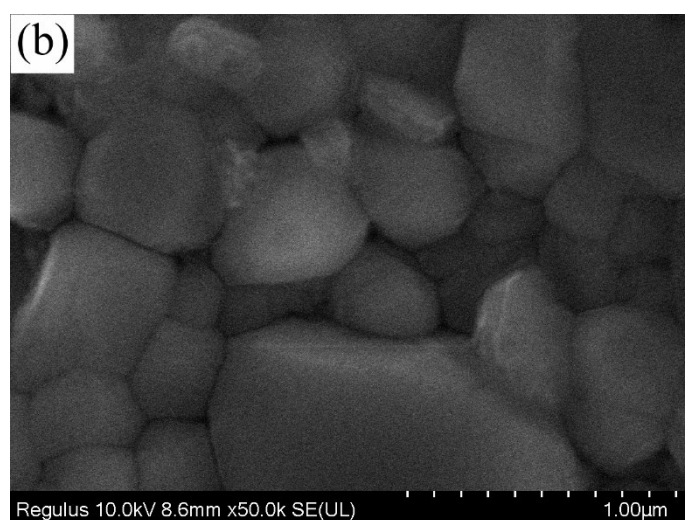
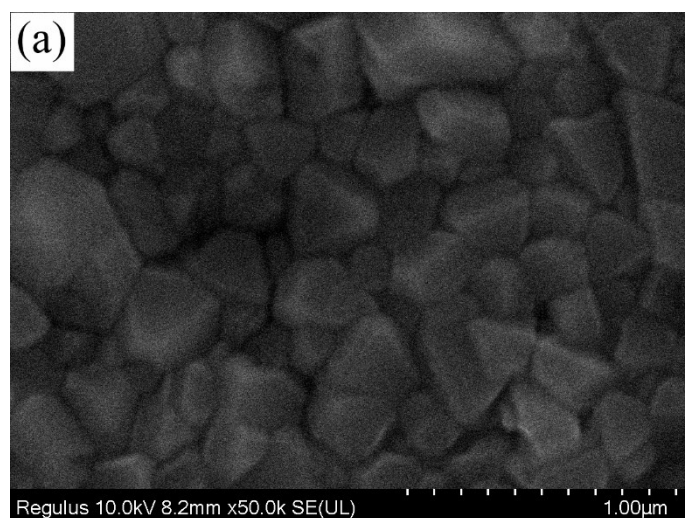


Figure S6 SEM images of perovskite on a) FeCl_3 , b) 5 nm and c) 20 nm Fe_2O_3 samples

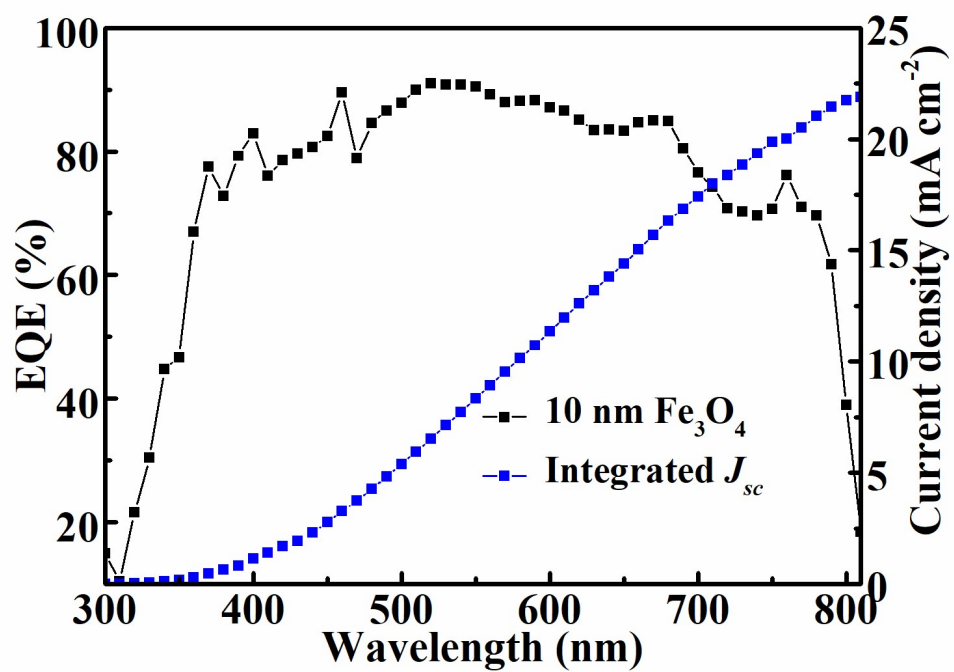


Figure S7 EQE and integrated J_{sc} of 10 nm Fe_3O_4 sample.

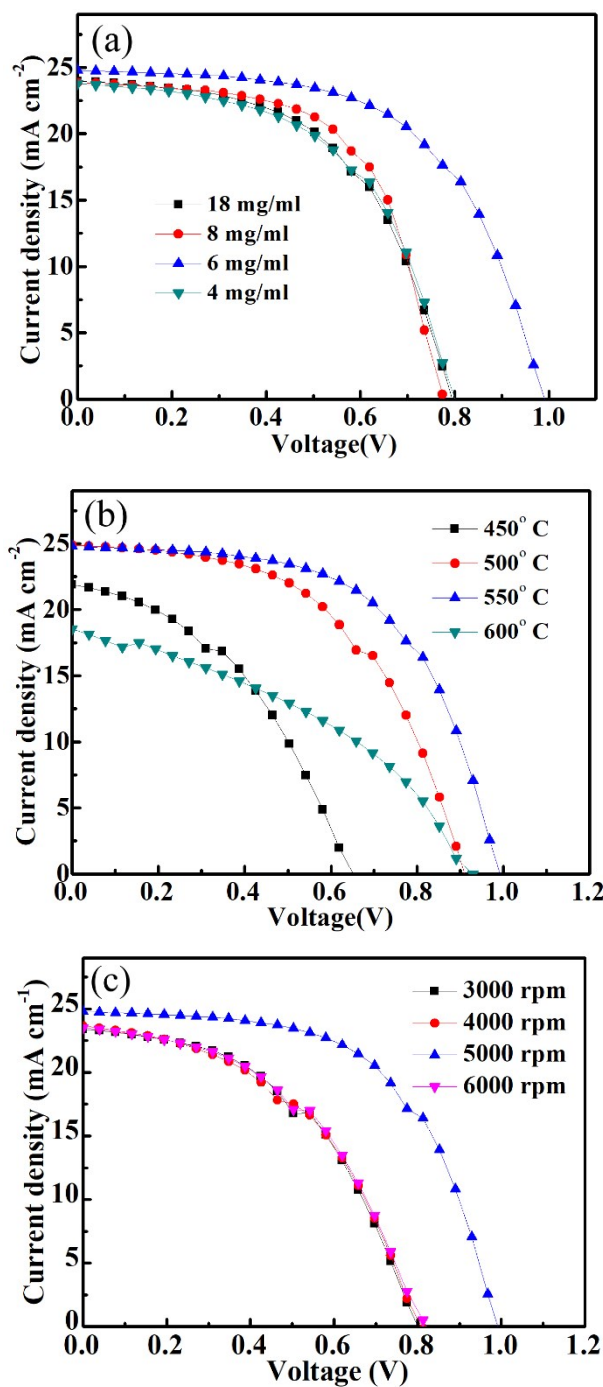


Figure S8. J-V curves of a) different concentration, b) temperature and c) spin speed samples.

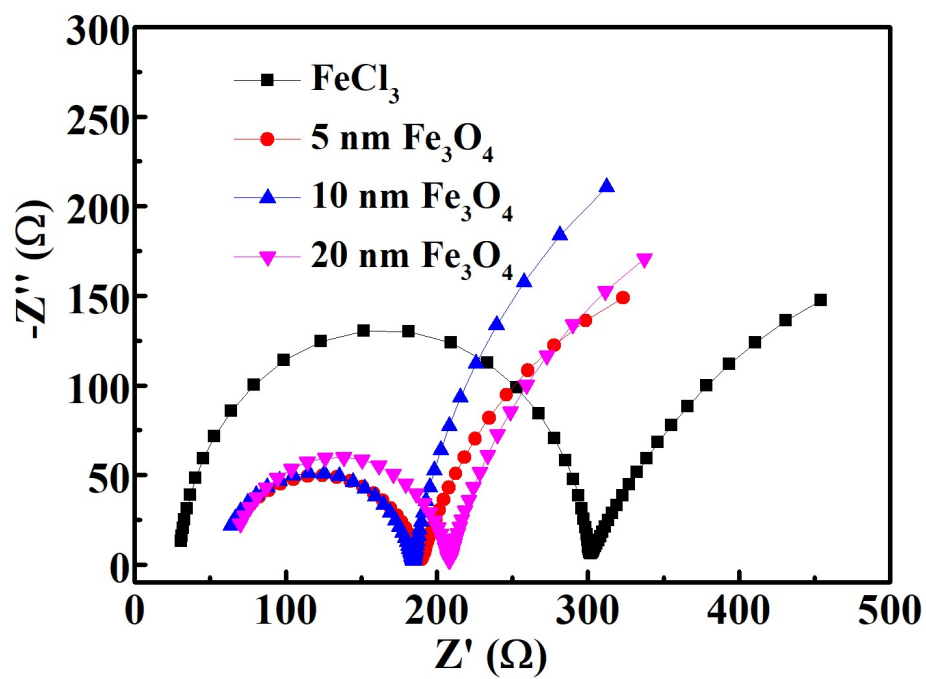


Figure S9. Fitted EIS of different Fe_2O_3 layer samples.

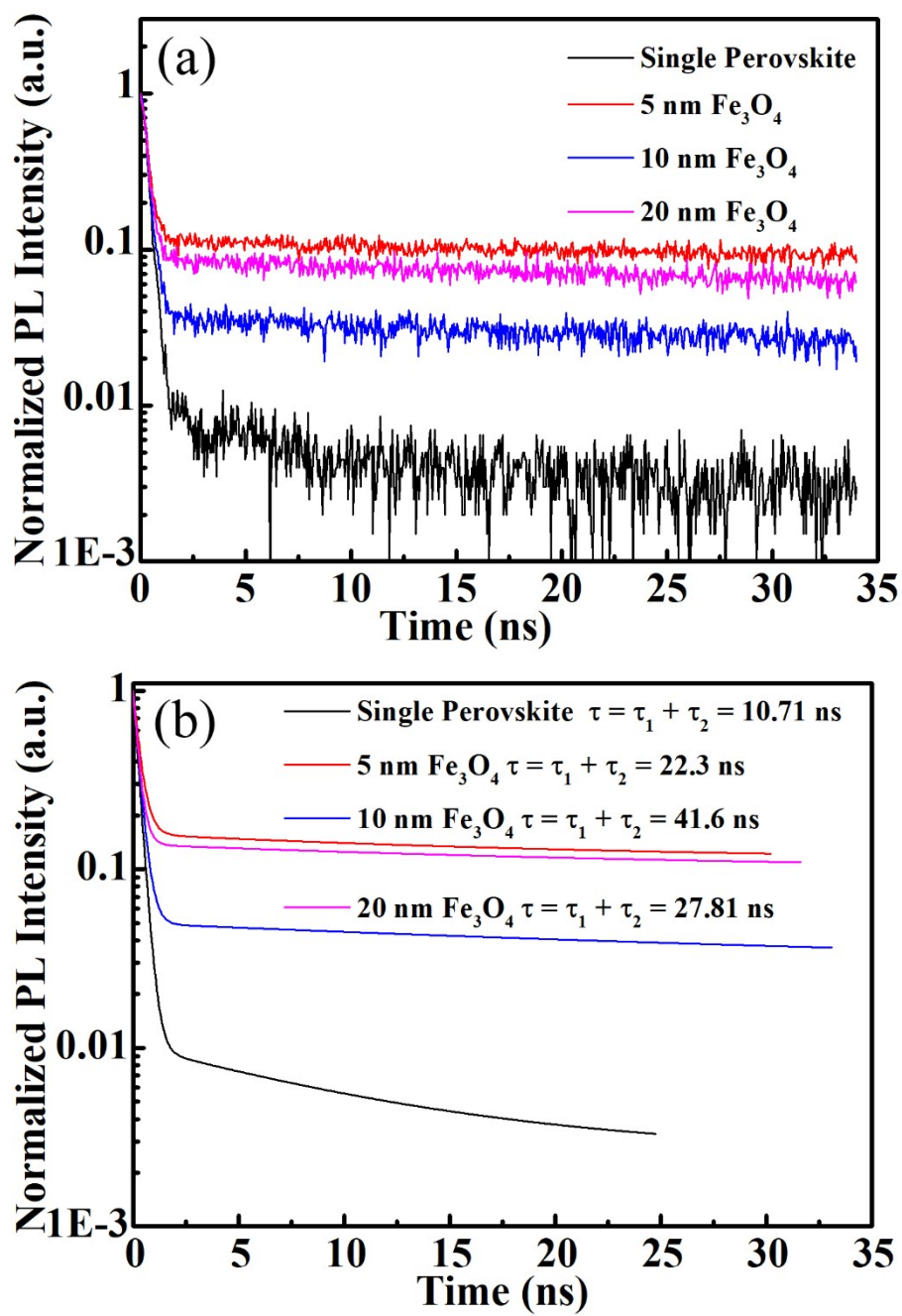


Figure S10 a) TRPL and b) Fitted TRPL curves of different samples

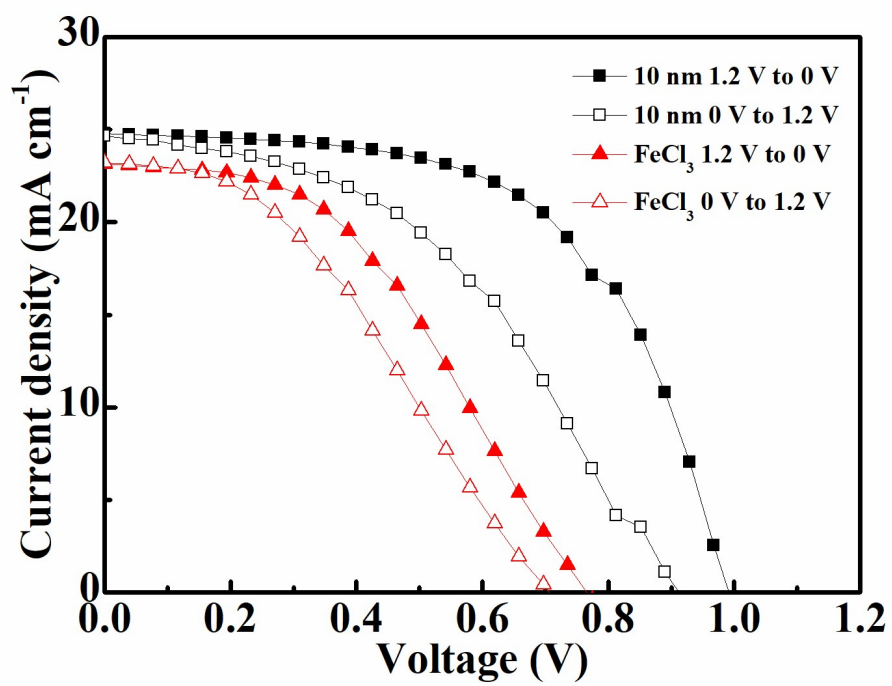


Figure S11. Forward and reverse scan of 10 nm and FeCl₃ samples.

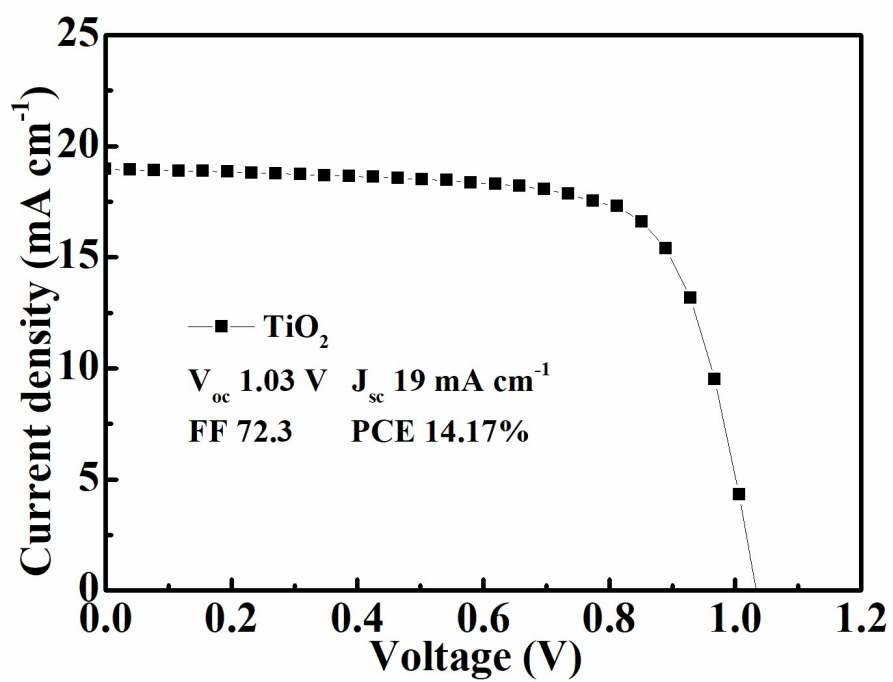


Figure S12. J-V curve of TiO₂ sample.

| Sample | V_{oc} (V) | J_{sc} (mA cm ⁻²) | Fill Factor (%) | Efficiency (%) |
|-------------------|--------------|---------------------------------|-----------------|----------------|
| FeCl ₃ | 0.78 ± 0.06 | 23.14 ± 0.06 | 43.52 ± 1.39 | 7.58 ± 0.32 |
| 5 nm | 0.91 ± 0.04 | 24.65 ± 0.16 | 47.82 ± 4.58 | 10.78 ± 0.90 |
| 10 nm | 0.97 ± 0.02 | 24.71 ± 0.21 | 54.60 ± 4.74 | 13.24 ± 1.14 |
| 20 nm | 0.97 ± 0.02 | 24.93 ± 0.30 | 49.16 ± 3.84 | 11.96 ± 1.02 |

Table S1. Summary of photovoltaic parameters of solar cells with different ETLs

| Sample | $R(\Omega)$ | $R_{ct} (\Omega)$ | $R_{rec} (\Omega)$ |
|-------------------|-------------|-------------------|--------------------|
| FeCl ₃ | 58.2 | 270 | 573 |
| 5 nm | 54.1 | 136 | 465 |
| 10 nm | 53.8 | 131 | 676 |
| 20 nm | 61.3 | 147 | 577 |

Table S2. The fitted values of R_{ct} and R_{rec} for solar cells.