

Electronic Supplementary Information

Efficient Planar Heterojunction Perovskite Solar Cell Employing Graphene Oxide as Hole Conductor

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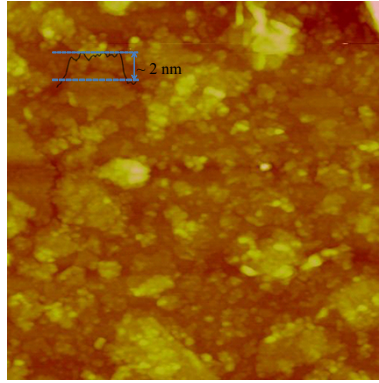


Fig. S1 AFM image of GO film spin-coated on Si substrates. The GO film is prepared from the suspension concentration of 0.25 mg/ml. The scan size is $1\ \mu\text{m} \times 1\ \mu\text{m}$.

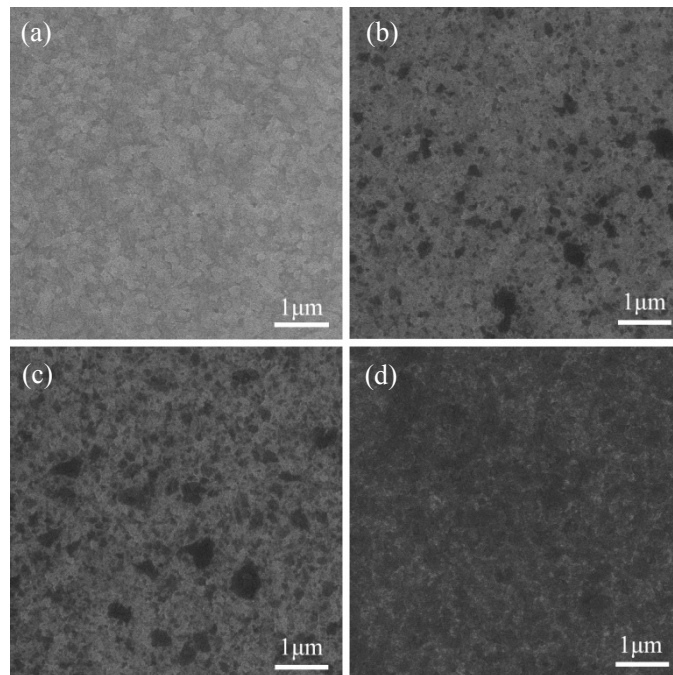


Fig. S2 SEM images of (a) bare ITO and ITO/GO substrates. The GO films were prepared from the suspension concentrations from 0.25 mg/ml to 4 mg/ml: (b) 0.25 mg/ml; (c) 1 mg/ml; (d) 4 mg/ml.

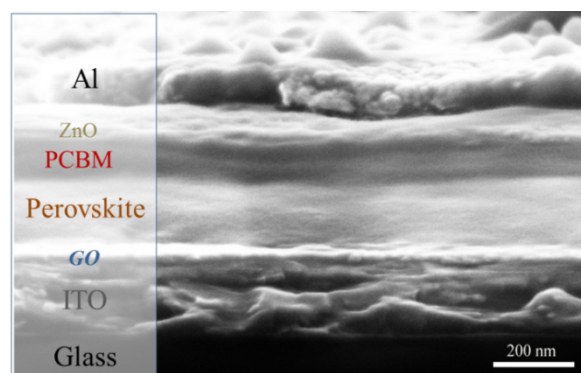


Fig. S3 Cross-sectional SEM image of the inverted device configuration with a 20-nm-thick GO layer.

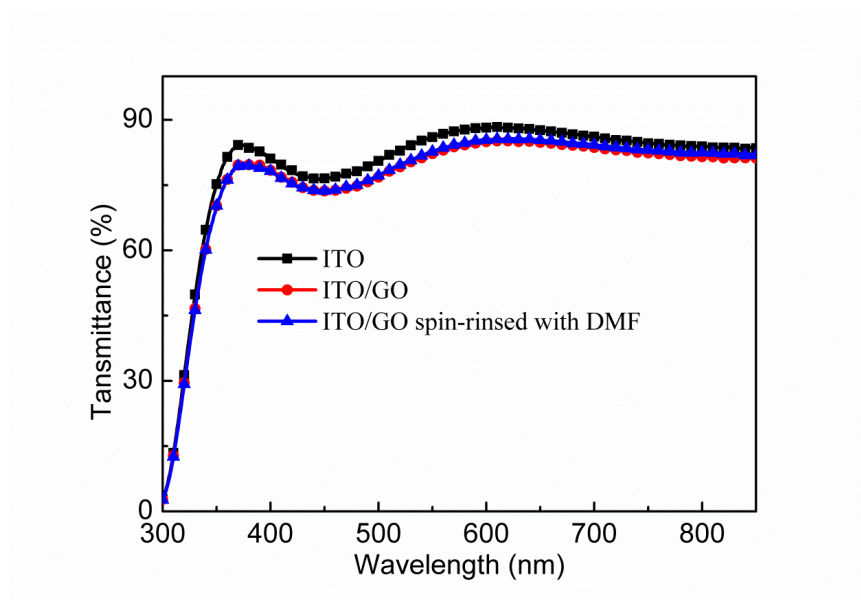


Fig. S4 The transmittance spectra of ITO, ITO/GO (20 nm) and ITO/GO (20nm) substrates spin-rinsed with DMF.

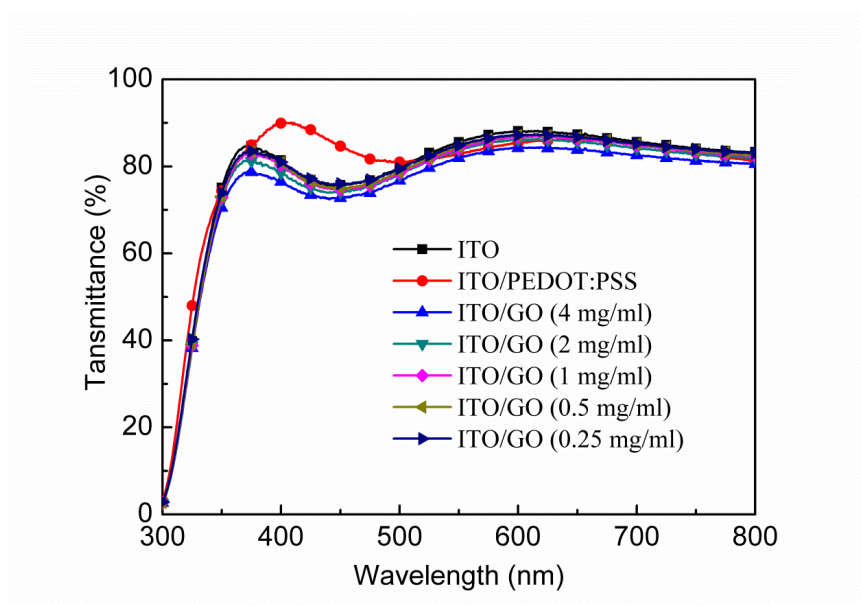


Fig. S5 The transmittance spectra of ITO, ITO/PEDOT and ITO/GO substrates. The thickness of GO is from 2 to 20 nm, and the films were prepared from the suspension concentrations from 0.25 mg/ml to 4 mg/ml.

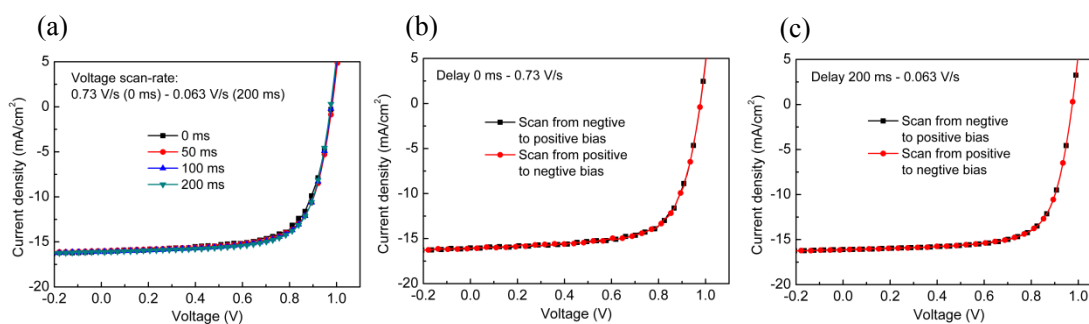


Fig. S6 (a) J–V curves of an optimal GO-based device measured with different delays between measurement points corresponding to voltage scan-rates ranging from 0.73 V/s to 0.063 V/s and different sweep directions with a voltage scan-rate of (b) 0.73 V/s and (c) 0.063 V/s.

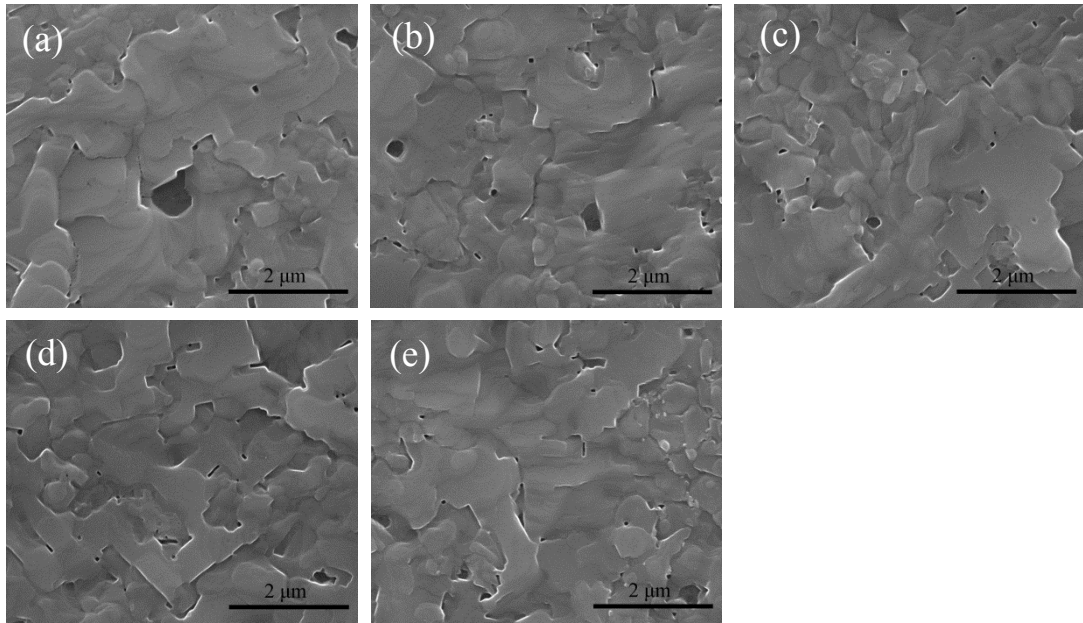


Fig. S7 SEM images of perovskite films ($\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$) on ITO/GO substrates.

The thickness of GO is from 2 to 20 nm, and the films were prepared from the suspension concentrations from 0.25 mg/ml to 4 mg/ml: (a) 4 mg/ml; (b) 2 mg/ml; (c) 1 mg/ml; (d) 0.5 mg/ml; (e) 0.25 mg/ml.

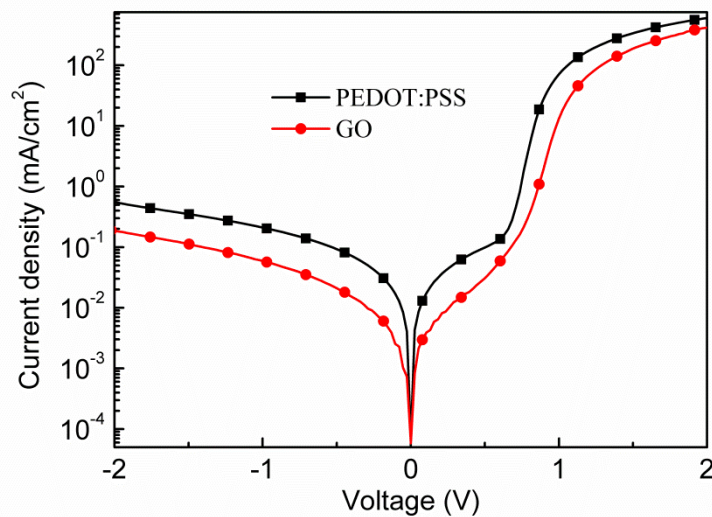


Fig. S8 J–V curves of inverted PHJ perovskite solar cell employing PEDOT:PSS or GO (2 nm) as hole conductor under dark condition.

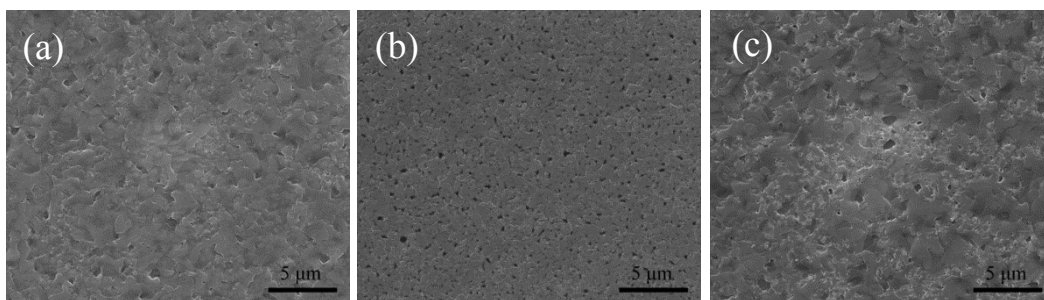


Fig. S9 Low resolution SEM images of perovskite films ($\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$) on the different substrates: (a) ITO/GO (2 nm); (b) ITO/PEDOT:PSS and (c) bare ITO.

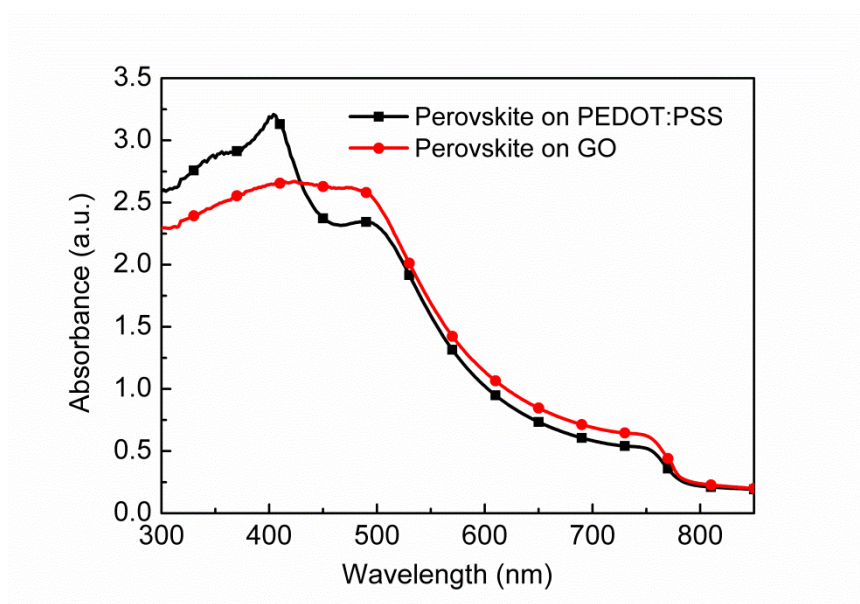


Fig. S10 UV-vis absorption spectra of perovskite films ($\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$) on ITO/PEDOT:PSS or ITO/GO (2 nm) substrates.