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Supplementary Information

Highly Conductive PEDOT:PSS and Graphene Oxide Hybrid Film with the Dipping Treatment by Hydroiodic Acid for Organic Light Emitting Diodes

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1. The sheet resistance and thickness

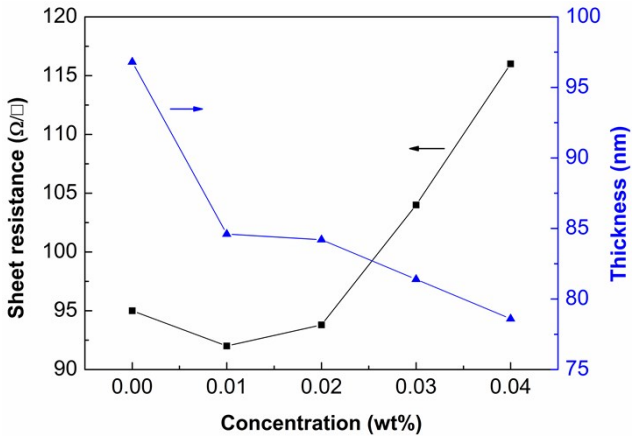

Fig. S1 The sheet resistance and thickness of PEDOT:PSS with 0-0.04 wt% GO hybrid films

The sheet resistance and thickness of the PEDOT:PSS:GO hybrid film are changed as a function of the added amount of GO. As shown in Fig. S1, the sheet resistance of the HI-treated PEDOT:PSS with 0.01 wt% and 0.02 wt% GO hybrid films are slightly reduced compared to that of pristine PEDOT:PSS film. The minimum sheet resistance of the PEDOT:PSS with 0.01 wt% GO hybrid film is about 92 ohm per square. The sheet resistance increases when more GO is added. On the other hand, the thickness of the hybrid film is dramatically decreased with the increase of GO concentration. This is mainly because of the dilution effect. The concentration of GO aqueous solution is kept at 3 mg/ml, which is much lower than that of the PEDOT:PSS solution (13 mg/ml). The addition of GO solution reduces the viscosity of the composite solution, consequently the thickness of the PEDOT:PSS film declines under same spin speed. For example, the thickness of 0.01 wt% GO hybrid film is 97.6 nm, 13.6 nm lower than that of pristine PEDOT:PSS film (about 84 nm).

2. The figure of merit

The optical and electrical performance of the hybrid film can be further characterized by the figure of merit ϕTC (as defined by Haacke[1]). The figure of merit ϕ_{TC} is defined by the following formula:

$$\varphi_{TC} = \frac{T_{av}^{10}}{R_{sh}} \quad (1)$$

where T_{av} is the transmittance at 550 nm and R_{sh} is the sheet resistance.[2]

Fig. S2 shows a plot of ϕ_{TC} as a function of the amount of GO. As shown in Fig. S1 and Fig. 2, the HI-treated PEDOT:PSS with 0.01 wt% GO hybrid film can obtain lower sheet resistance and similar transmittance comparing to pristine PEDOT:PSS film. Therefore, the HI-treated PEDOT:PSS with 0.01 wt% GO hybrid film has the best figure of merit of about $3.8\times10^{-3}\ \Omega^{-1}$, which is higher than that of pristine PEDOT:PSS film (about $3.6\times10^{-3}\ \Omega^{-1}$). After adding

more GO, the ϕ_{TC} becomes much lower, because the addition of GO sheets will further reduce the average transmittance and increase the sheet resistance of the hybrid films.

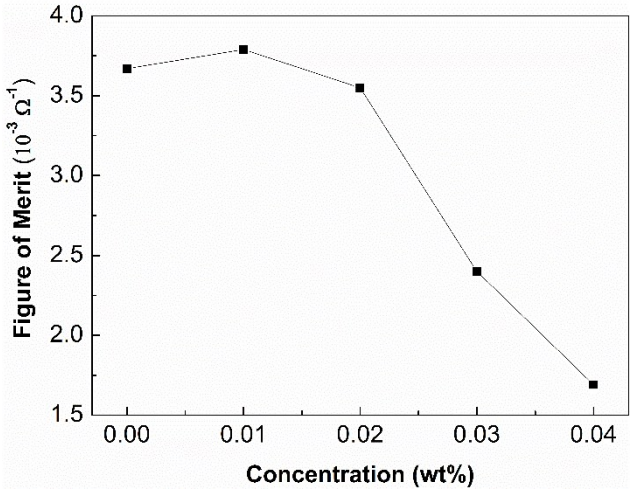

Fig. S2 Figure of merit of PEDOT:PSS:GO hybrid films as a function of the amounts of GO

3. UPS Spectra

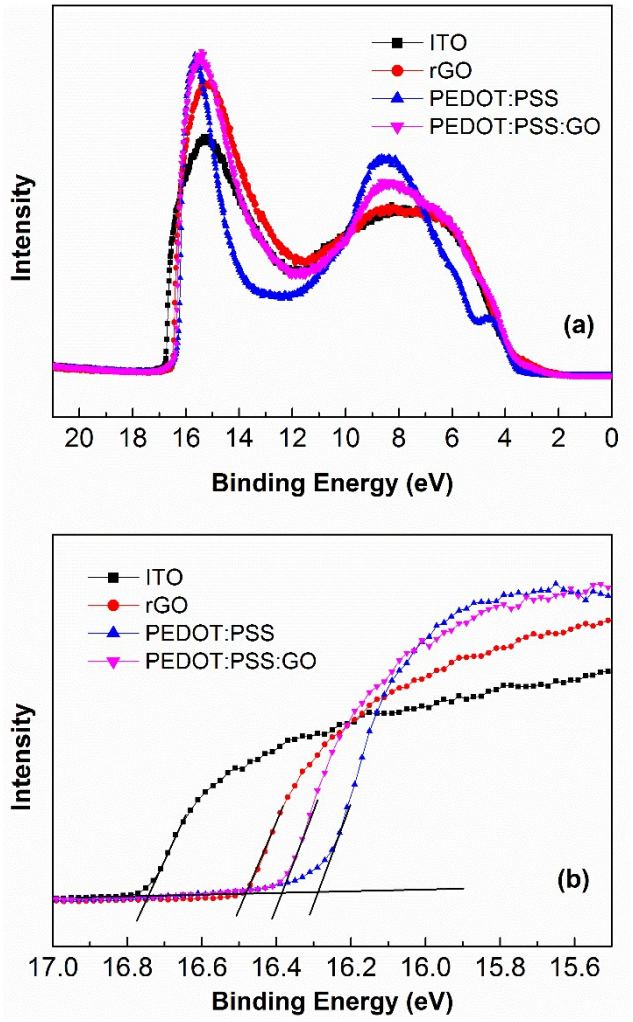

Fig. S3 UPS spectra of ITO, rGO, PEDOT:PSS and PEDOT:PSS:GO films with HI treatment, including (a) the full UPS

spectrum using He I radiation of 21.2 eV and (b) secondary-electron cutoff

1 G. Haacke, *J. Appl. Phys.,* 1976, **47**, 4086.

2 D. Aritra and T. L. Alford, *J. Appl. Phys.,* 2012, **112**, 103113.