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Supplementary Information

Light–emitting & detecting bifunctional device based on bias–selective redox activity of polymer

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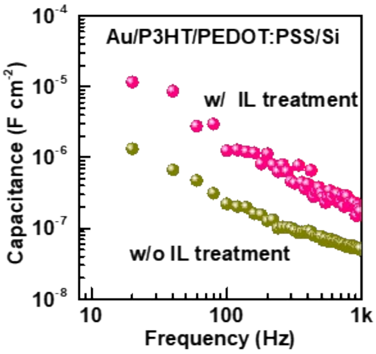

Fig. S1. Measured capacitance with respect to the frequency. 0 V of voltage and 0.05 V of amplitude of AC was applied.

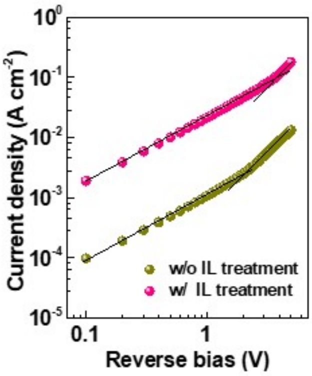

Fig. S2. Space charge limit current model (SCLC) fitting of hole–only PC devices.

Charge carrier mobility can be estimated in the SCLC regime can be represented by the following equation:

$$J = 9\varepsilon_0\varepsilon_r\mu_h(V - V_{bi})^2/8L^3, \qquad (1)$$

where J is current density, ε_0 is the permittivity of free space, ε_r is the dielectric constant of the active layer, μ_h is the hole mobility, V_{bi} is the built in potential of the device and L is the active layer thickness. To find out the ratio between hole mobility of IL–treated photoconductor (PC) and untreated one, the equation can be simplified as below:

$$\mu_{h,2}/\mu_{h,1} = \left(\frac{J_2}{\varepsilon_{r,2}(V_2 - V_{bi,2})^2}\right) / \left(\frac{J_1}{\varepsilon_{r,1}(V_1 - V_{bi,1})^2}\right), \qquad (2)$$

where the subscript of 1 means the parameter belongs to the untreated PC and subscript of 2 means the parameter belongs to the IL–treated PC. As the IL–treatment does not affect the active layer thickness (absorbance did not change, see Fig. 3a.), ratio of ε_r can be regarded as equal to the ratio of capacitance (~ 5) measured in Fig. S1. With simple calculation, the hole mobility ratio between IL–treated PC and untreated one was about 15 in SCLC regime.

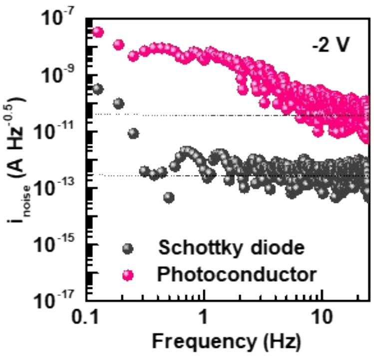

Fig. S3. Measured noise current for P3HT-based Schottky diode and photoconductor. -2 V was applied.

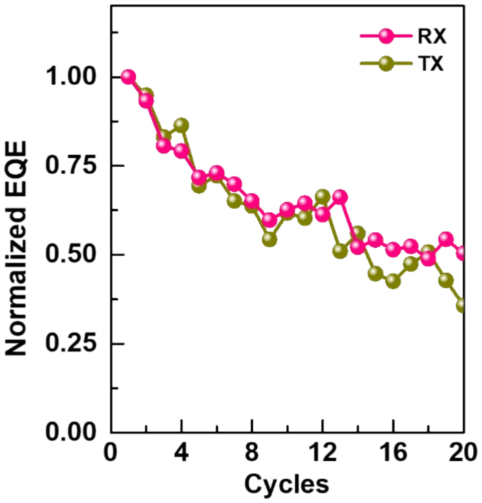

Fig. S4. Measured normalized EQE of the dual-mode device in both RX (photodetector) and TX (light-emitter) modes during consecutive TX-to-RX switching.