Electronic Supplementary Material (ESI) for Nanoscale.

Supporting information

Schottky barrier-gated high performance photodetector using a water-borne polymeric colloid

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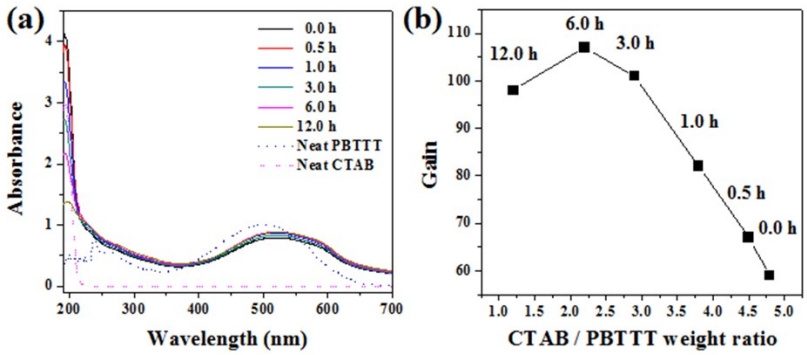

Figure S1. (a) The UV-vis spectra of time-dependent PBTTT nanoparticle dispersions.

***Experimental details to optimize dialysis time*:** The photoconductive gain value of photoconductor is directly proportional to charge carrier mobility. Therefore, we can expect that the photoconductive gain would be increased along with decrease of the contents of CTAB because the surfactant is electrically inert. We have inserted the dialysis process during the nanoparticle fabrication for elimination of CTAB. As demonstrated in the manuscript, we prepared the cellulose dialysis tubes and used as a container of PBTTT nanoparticle dispersion. Driven by the concentration difference, the excess CTAB could be removed. At every 30 minutes of dialysis process, the PBTTT nanoparticle dispersion was extracted and measured by a UV-vis absorption spectroscopy. As shown from the absorption spectrum of pristine CTAB, one can see that the absorption feature appearing at ~190 nm corresponds to the intramolecular charge transfer in CTAB. Then, by measuring the absorption spectra of PBTTT nanoparticle dispersions with various contents of CTAB as a function of dialysis time, one can estimate the CTAB/PBTTT ratio (weight/weight), based on Beer-Lambert law as described in the equation S1.

$$A = \varepsilon_{CTAB} b C_{CTAB} + \varepsilon_{PBTTT} b C_{PBTTT} \qquad \text{(S1)}$$

where A is the absorbance, ε is extinction coefficient, b is the length of light pathway, C is the concentration. As summarized in Figure S1(a), the absorption feature at ~190 nm gradually decreases as dialysis time increases. Then, we have plotted the co-relations between the photoconductive gain and the relative weight ratio of CTAB to PBTTT used in the Schottky photoconductor as shown in Figure S1(b). Clearly, there was an optimal ratio of ~ 2 and higher contents of CTAB only resulted in lower gain values, presumably due to the electrically inert nature of CTAB. At the same time, too low contents (< ca.2) also decreased the gain value, possibly due to the formation of inter-particle aggregation.

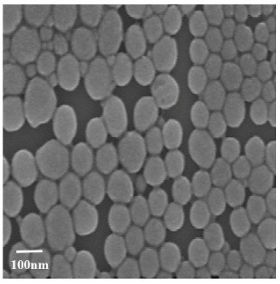

Figure S2. The SEM image of PBTTT colloid.

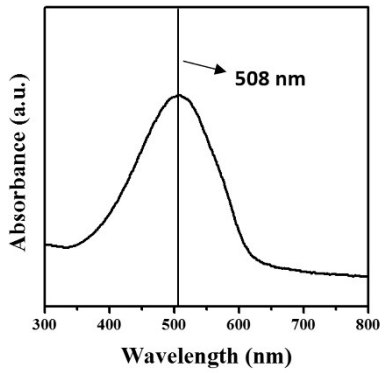

Figure S3. The UV-Vis absorption spectrum of PBTTT thin films after thermal treatment at 240˚C.

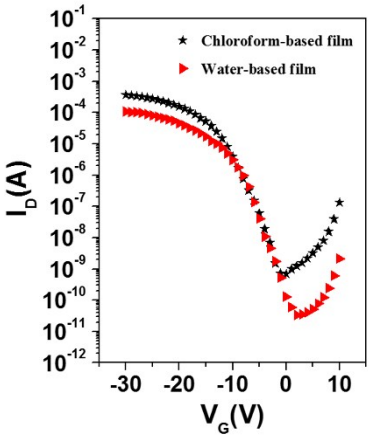

Figure S4. The transfer characteristics of FET devices with the active layers deposited from chloroform solution and water-borne colloid.

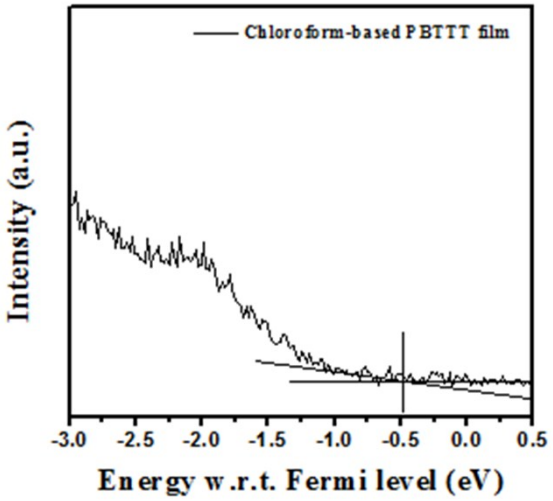

Figure S5. The UPS spectrum of chloroform-based PBTTT film.

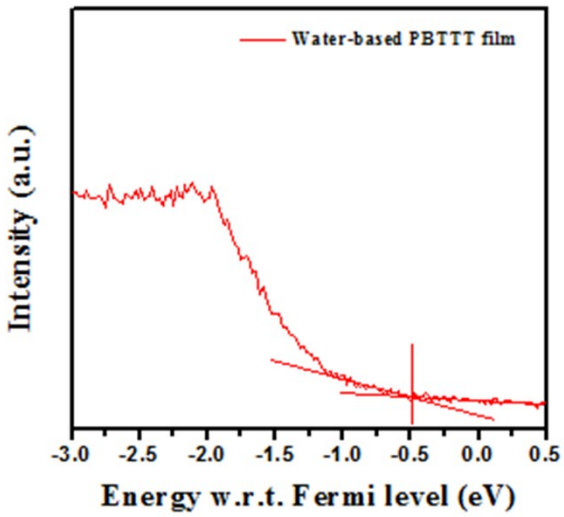

Figure S6. The UPS spectrum of water-based PBTTT film.

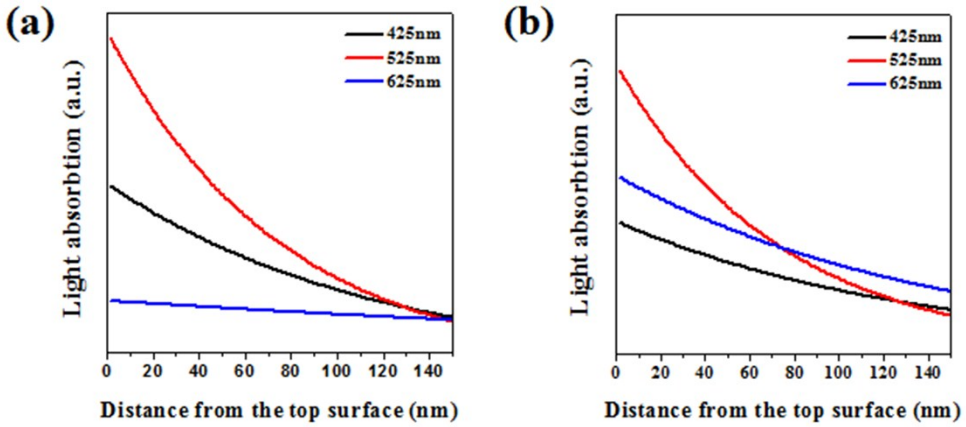

Figure S7. The optical simulation of (a) ohmic photoconductor and (b) Schottky photoconductor by using transfer matrix method.