

Supplementary information of:

Carbon nanodots and fulleropyrrolidine derivatives-based heterostructures for improving the charge separation and the photocurrent generation

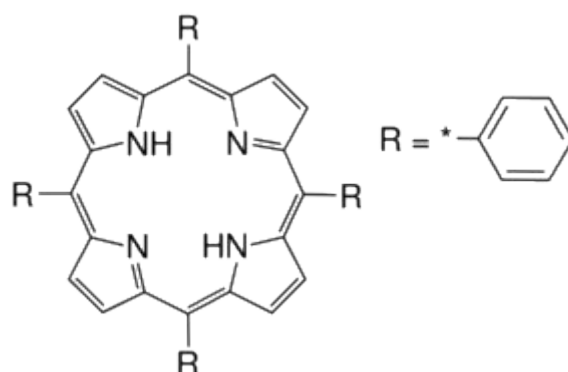


Figure S1. Chemical structure of the commercial porphyrin derivative TPyP (5,10,15,20-Tetra(4-pyridyl)-21H,23H-porphine).

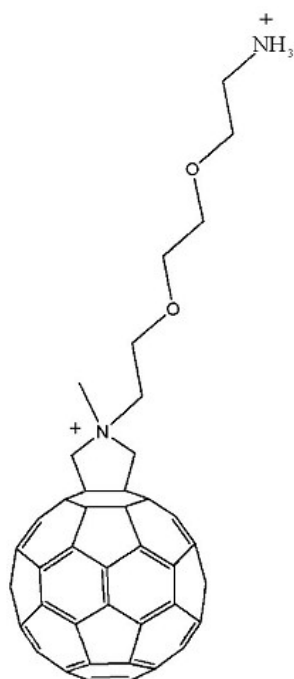
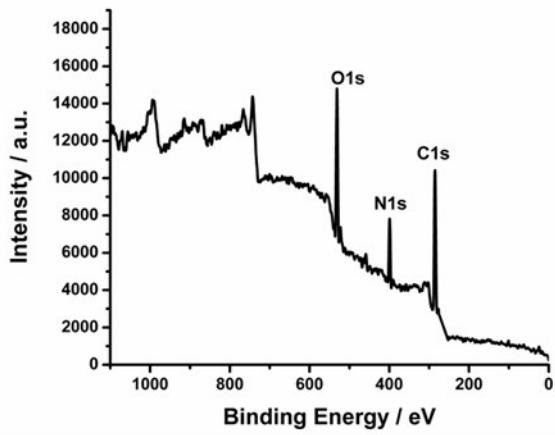
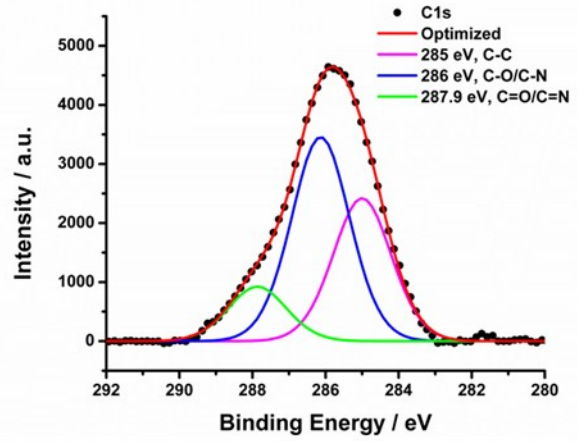


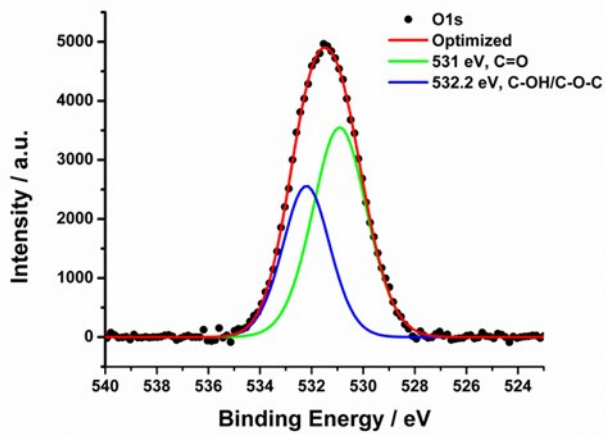
Figure S2. Chemical structure of the fulleropyrrolidine derivative FP2



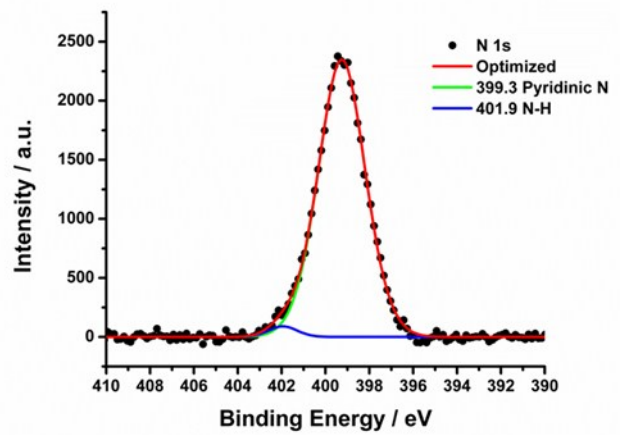
a



b



c



d

Figure S3 a) XPS survey spectrum of CNDs; high resolution peaks of C1s (b), O1s (c) and N1s (d).

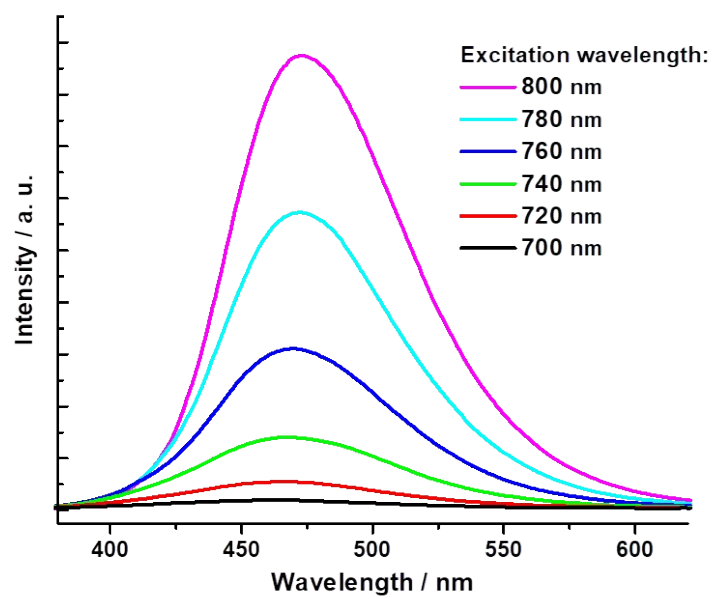


Figure S4. Upconversion characteristic evidenced by the CNDs

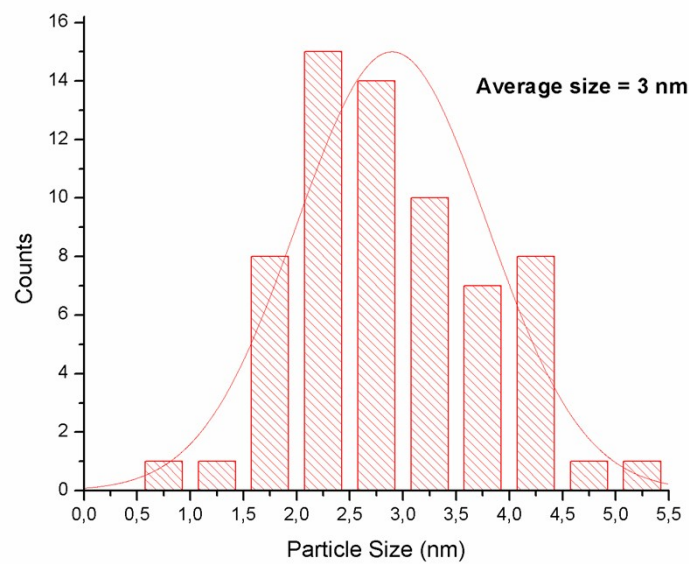


Figure S5 Size-distribution of the CNDs show that structures with an average diameter of 3 nm were obtained.

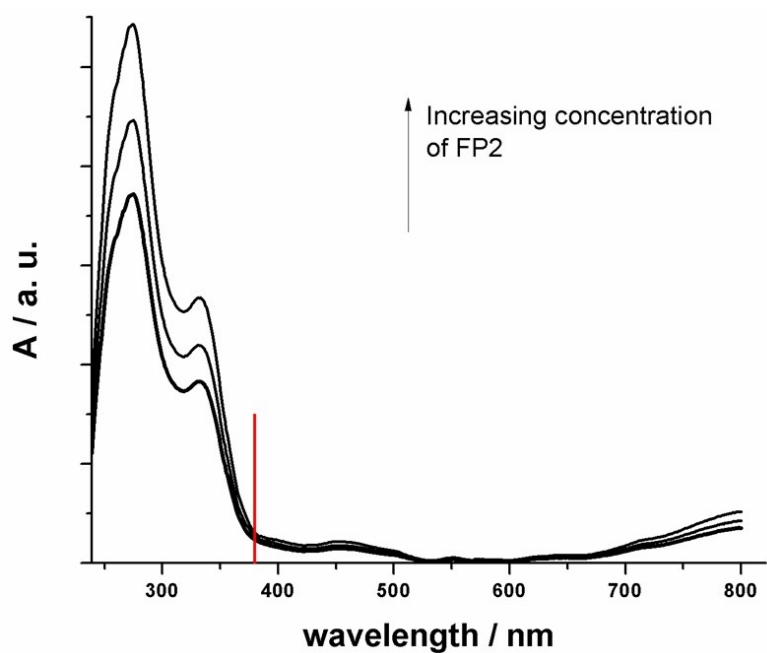


Figure S6 UV-Visible spectra of FP2 in chloroform solution at different concentration. The vertical line indicates the excitation wavelength (380 nm) and it is reported in order to highlight that the FP2 absorption at 380 nm does not substantially change increasing the fulleropyrrolidine derivative concentration.

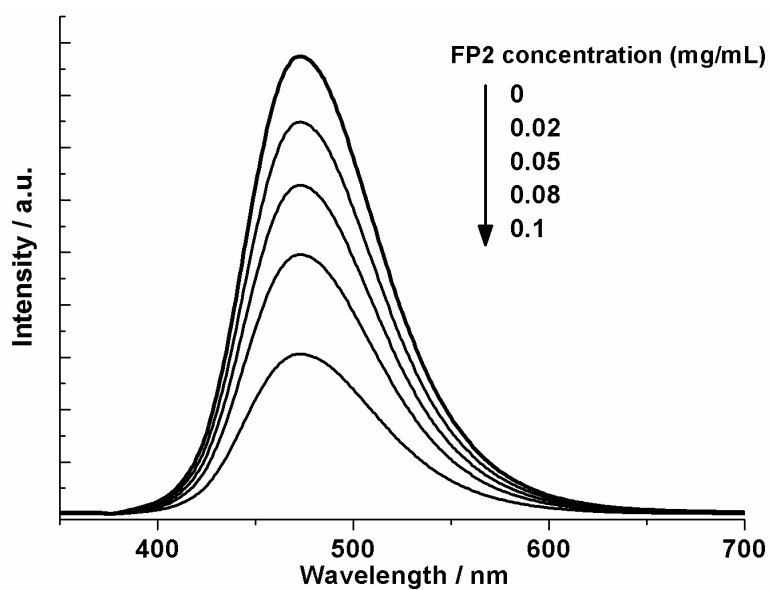


Figure S7. Quenching effect of the upconversion emission of CNDs ($\lambda_{exc}=800$ nm) at different concentration of FP2.

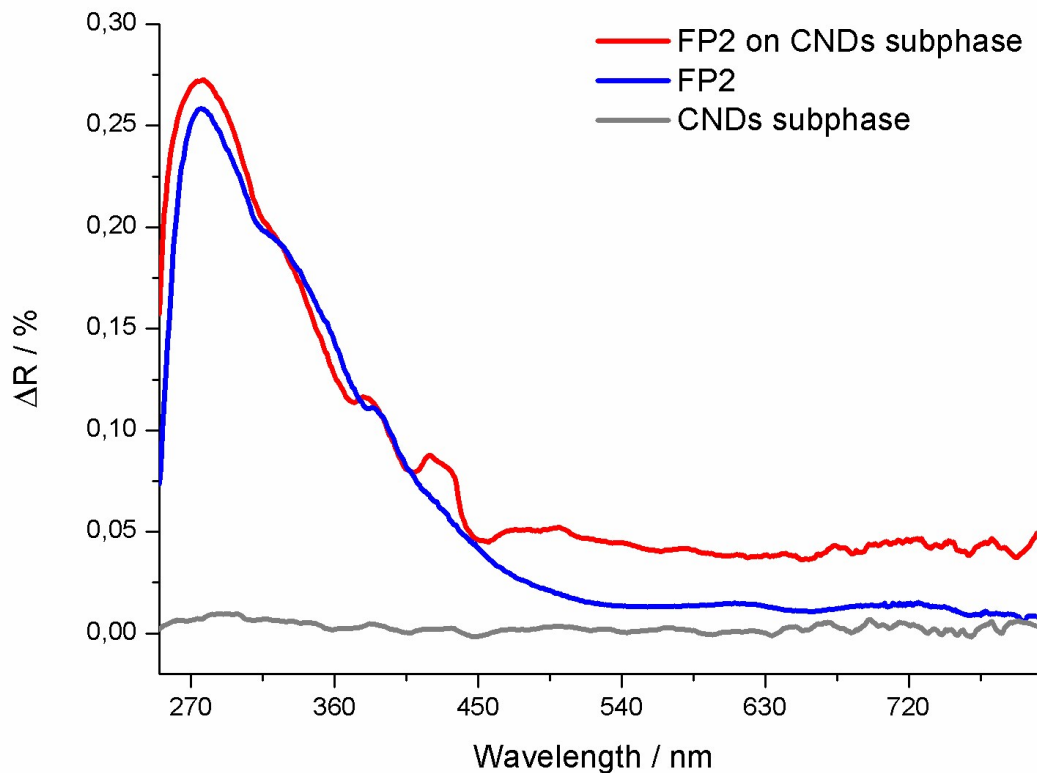


Figure S8. Reflection spectra of the FP2 floating film formed on ultrapure water subphase (blue line) and subphase containing CNDs (0.044 mg/mL). Reflection spectrum of the CNDs dissolved in the subphase was acquired (grey line) and no reflection bands were observed.

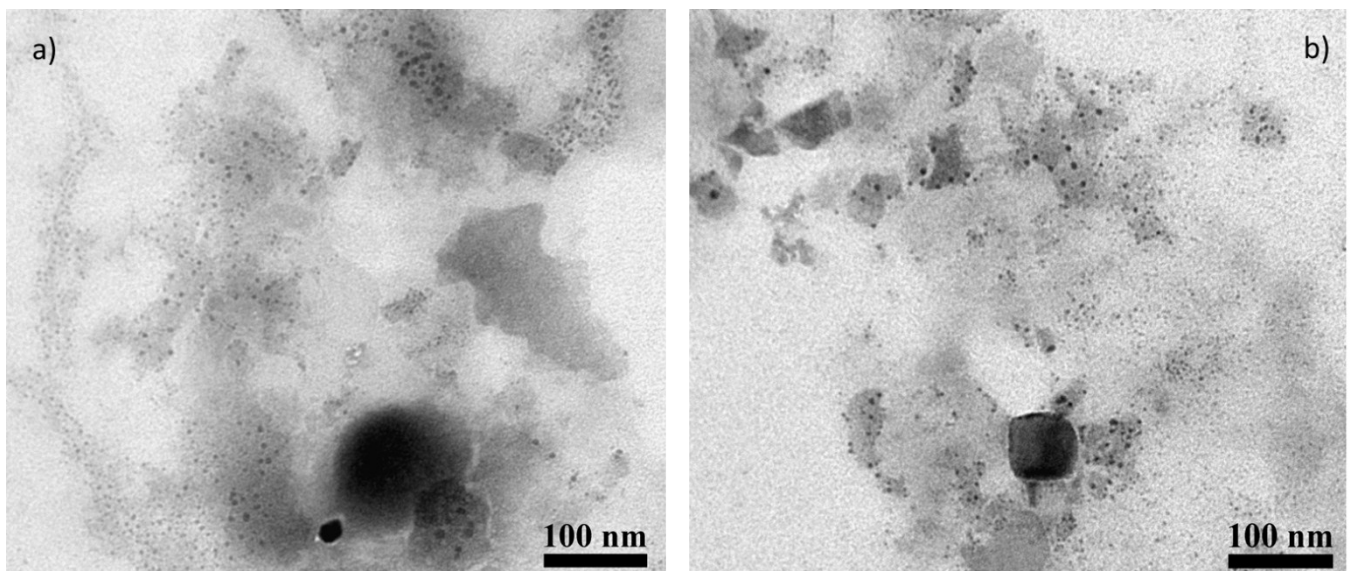


Figure S9. TEM images of 1 LS run of FP2/CNDs dyad obtained on two different samples in order to check the reproducibility of CNDs/FP2 dyad transfer process. The pictures a) and b) confirm that the CNDs are embedded in the FP2 domains.

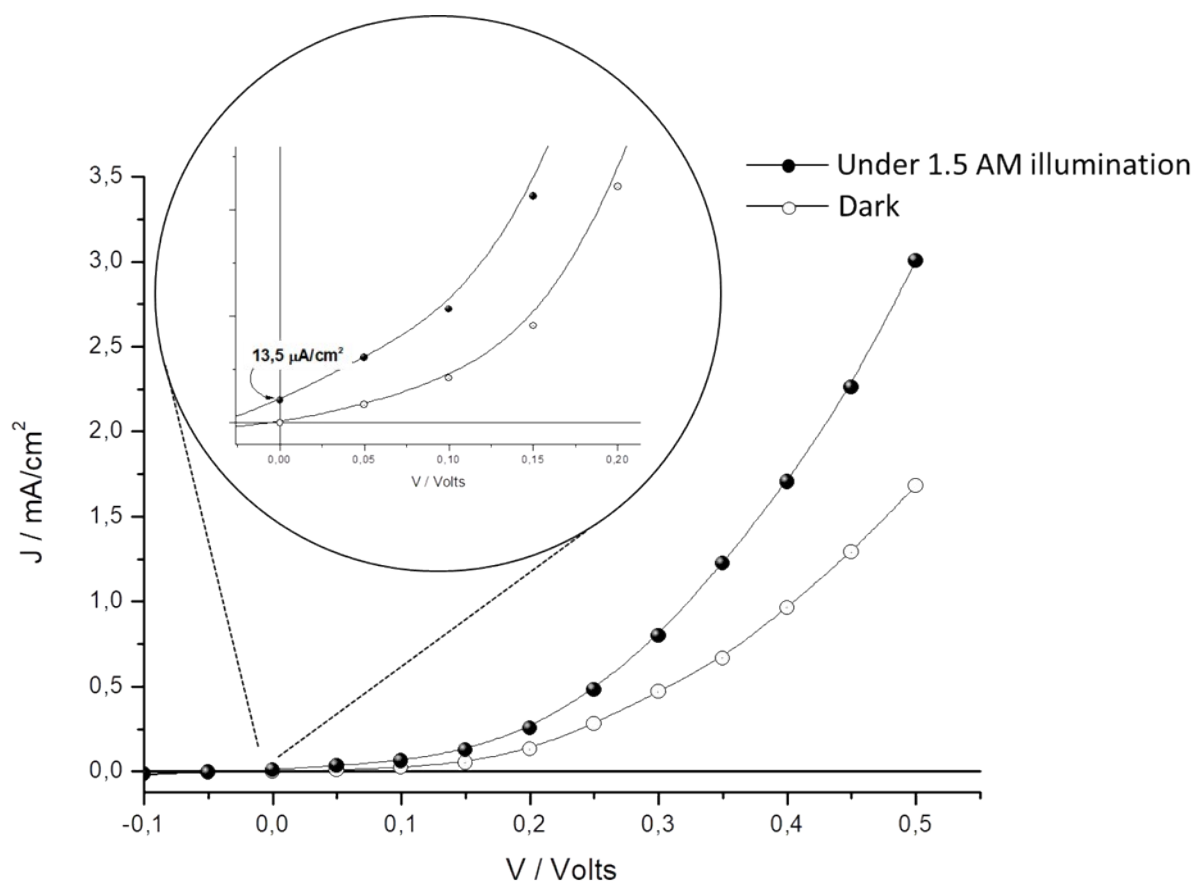


Figure S10. JV characteristics using the supramolecular adduct as active layer under 1.5 AM illumination (filled circles) and in the dark (empty circles). In the inset, a magnification of the JV in the range 0-0.2V and 0-0.15 mA/cm² is reported in order to highlight the J_{sc} recorded under illumination.

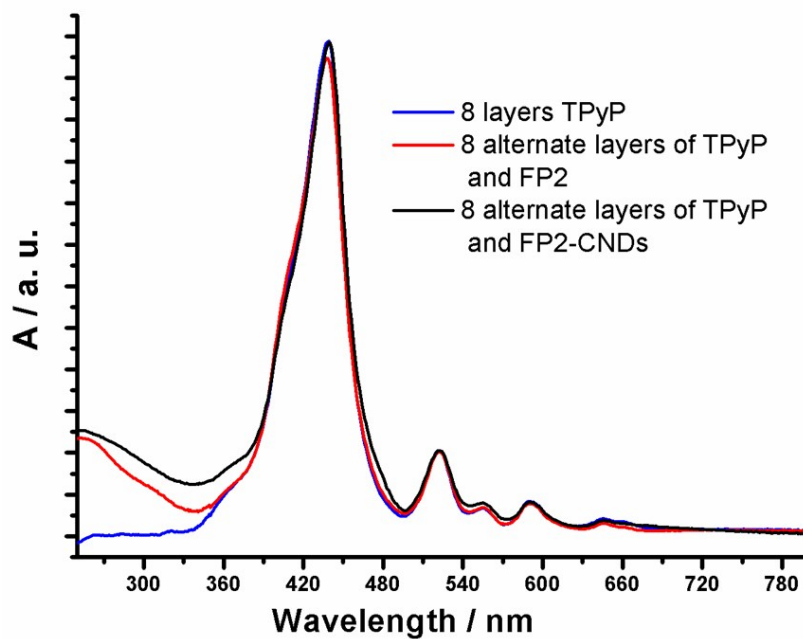


Figure S11 UV-visible spectra of 8 LS layers of TPyP (blue line), 8 alternate layers TPyP-FP2 (red line) and 8 alternate layers TPyP-FP2/CNDs (black line)

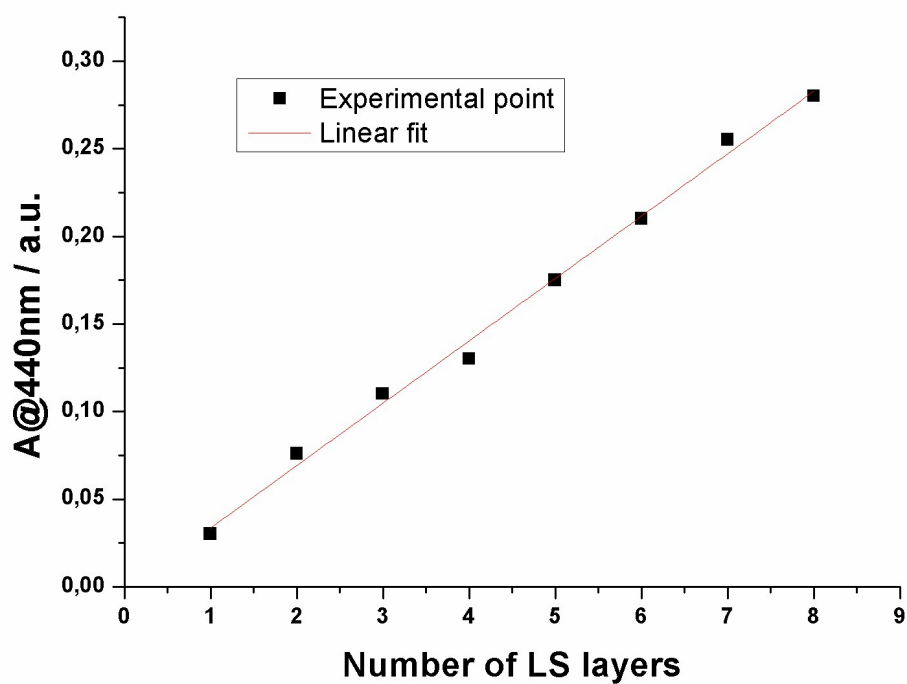


Figure S12 Linear correlation between the TPyP at 440 nm and the number of LS layers. Experimental points (black squares) were fitted by a linear fit and a Rsquare of 0.994 was obtained.

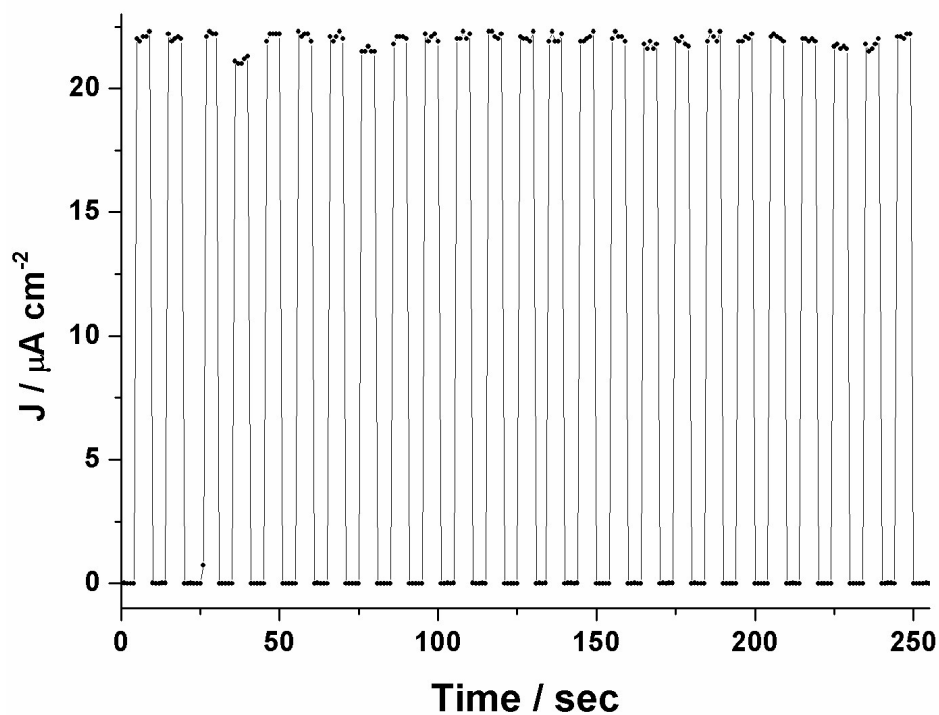


Figure S13. Response stability of the photo-active layer TPP/FP2-CNDs under 25 on-off light cycles.