Electronic Supplementary Information

Optically enhanced charge transfer between C_{60} and single-wall carbon nanotubes in hybrid electronic devices

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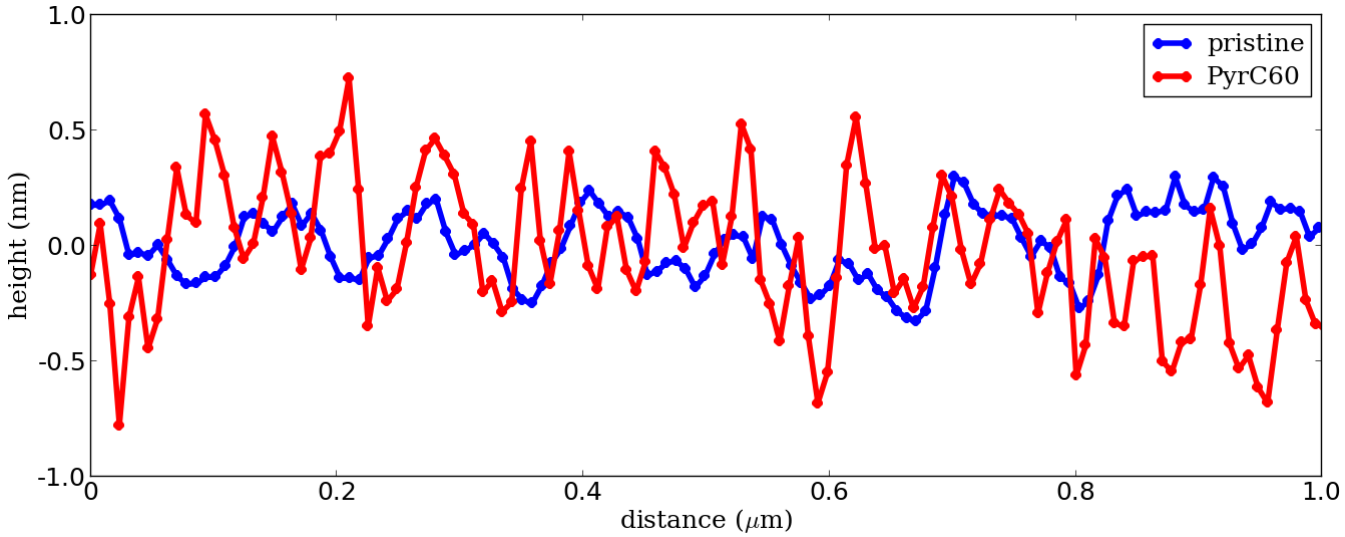

Figure S1. AFM line scans across the silicon substrate for pristine (blue) and functionalized (red). The standard deviations of the data are 1.5×10^{-10} m and 3.0×10^{-10} m respectively.

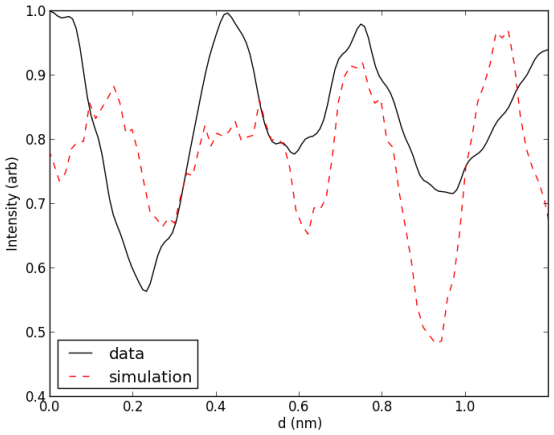

Figure S2. Line scan across the center of the C_{60} molecule taken from the TEM image shown in figure 3h (black) and from the simulation shown in figure 3i (red) giving C_{60} diameters of 0.71 nm and 0.68 nm respectively.

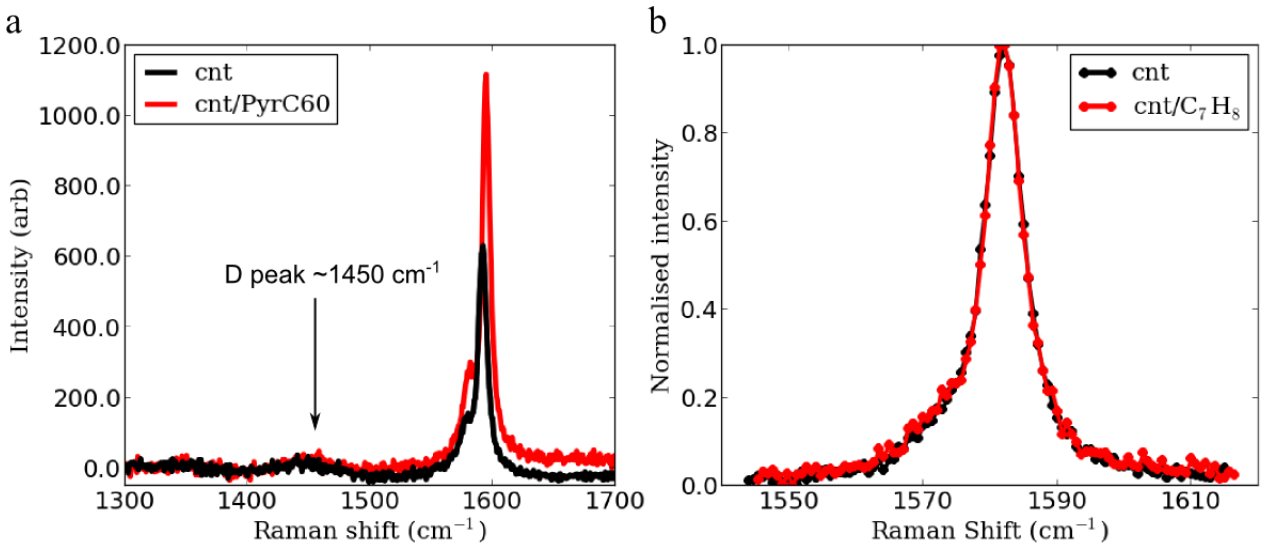

Figure S3. a. Raman spectra raw data (after background subtraction) of the pristine (black) and functionalized (red) SWCNT. There is no appreciable increase in D peak amplitude with functionalization. **b.** Raman spectra G peak of another device measured pristine (black) and after applying two drops of toluene and allowing to dry (red).

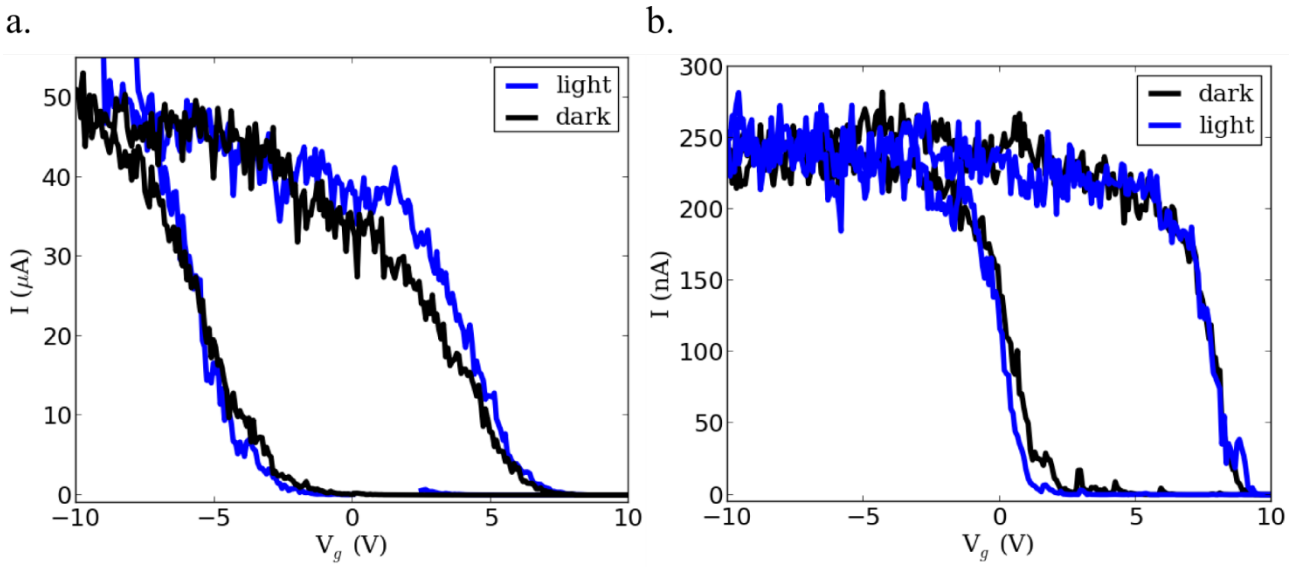

Figure S4. Typical transfer properties of pristine CNTFET devices. **a.** The ~250 nm device shown in figure 2. **b.** a ~ 450 nm device. No significant optical response is seen.

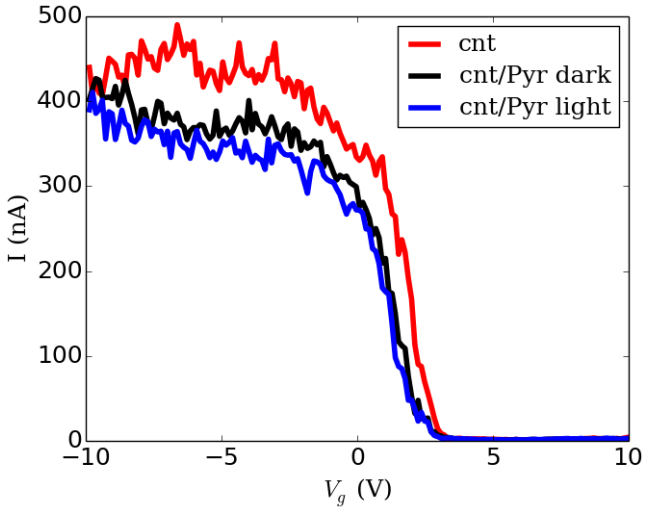

Figure S5. Typical transfer properties of a control device in its pristine state (red) and after functionalization measured in the dark (black) and under illumination (blue). No significant optical response is seen. These measurements were performed using a pulsed measurement technique and only the up sweep is shown for clarity.

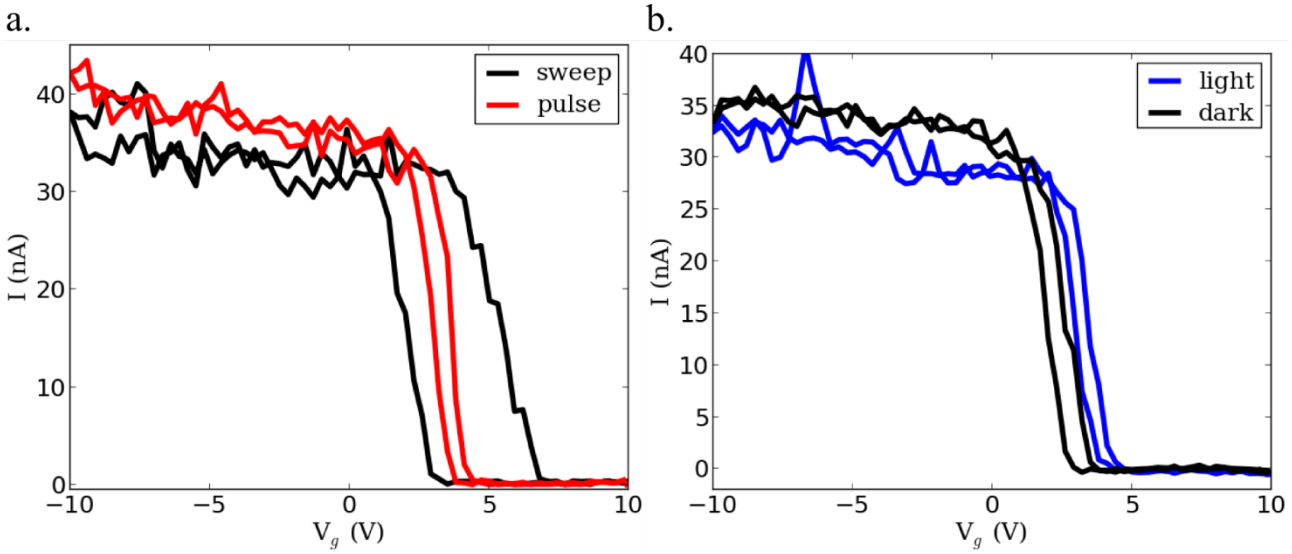

Figure S6. a. Comparison between the transfer curves of the ~250 nm device measured with a standard gate voltage sweep (black curve) and with a pulsed gate voltage sweep (red curve) showing much reduced hysteresis. **b.** Full pulsed hysteresis curves for light (blue) and dark (black) measurements.

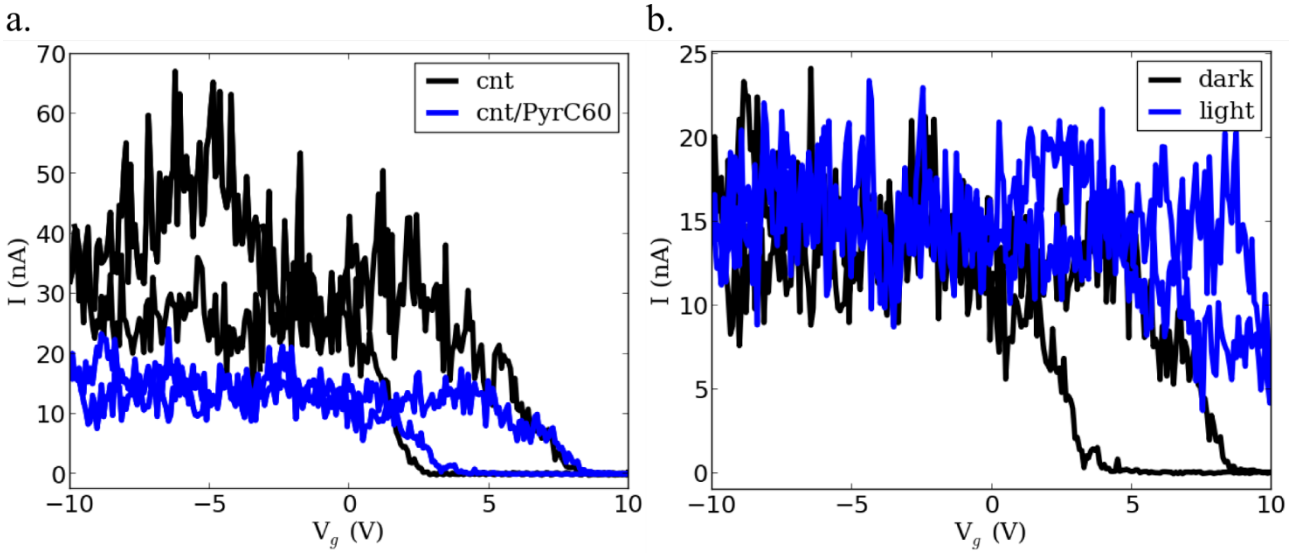

Figure S7. a. Transfer characteristics of a ~550 nm CNTFET device measured with V_{sd} = 0.1 V before (black) and after (blue) functionalization with the Pyr-C_{60} moiety. **b.** The functionalized CNTFET measured in the dark (black curve) and under illumination from a 150W halogen lamp (blue curve).

Figure S6a shows the transfer characteristics of a CNTFET device with channel length of ~550 nm. The pristine device has up sweep threshold voltage $V_{th,u}^{p}$ ~ 2.5 V, corresponding to a field effect mobility of $\mu_{FE,u}^{p}$ ~ 25 cm^2/Vs, and down sweep threshold voltage $V_{th,d}^{p}$ ~ 7.9 V, and mobility $\mu_{FE,d}^{p}$ ~ 22 cm^2/Vs. The functionalized device has parameters $V_{th,u}^{f}$ ~ 3.4 V, $\mu_{FE,u}^{f}$ ~ 18 cm^2/Vs, $V_{th,d}^{f}$ ~ 8.4 V, $\mu_{FE,u}^{f}$ ~ 13 cm^2/Vs.

Figure S6b shows the functionalized CNTFET measured in the dark and under illumination by a 150 W halogen lamp. The transfer parameters when measured in the dark are $V_{th,u}^{f,d} \sim$ 3.4 V, $\mu_{FE,u}^{f,d} \sim$ 18 cm^2/Vs, $V_{th,d}^{f,d} \sim$ 8.4 V, $\mu_{FE,u}^{f,d} \sim$ 13 cm^2/Vs. The transfer parameters when measured in the light are $V_{th,u}^{f,l} \sim$ = 12.8 V, $\mu_{FE,u}^{f,l} \sim$ 4.2 cm^2/Vs, $V_{th,d}^{f,l} \sim$ 11.4 V, $\mu_{FE,u}^{f,l} \sim$ 13 cm^2/Vs. As under illumination the SWCNT/Pry-C$_{60}$ device does not fully reach an 'off' state within the V_g sweep range the extracted FET parameters are somewhat unreliable.

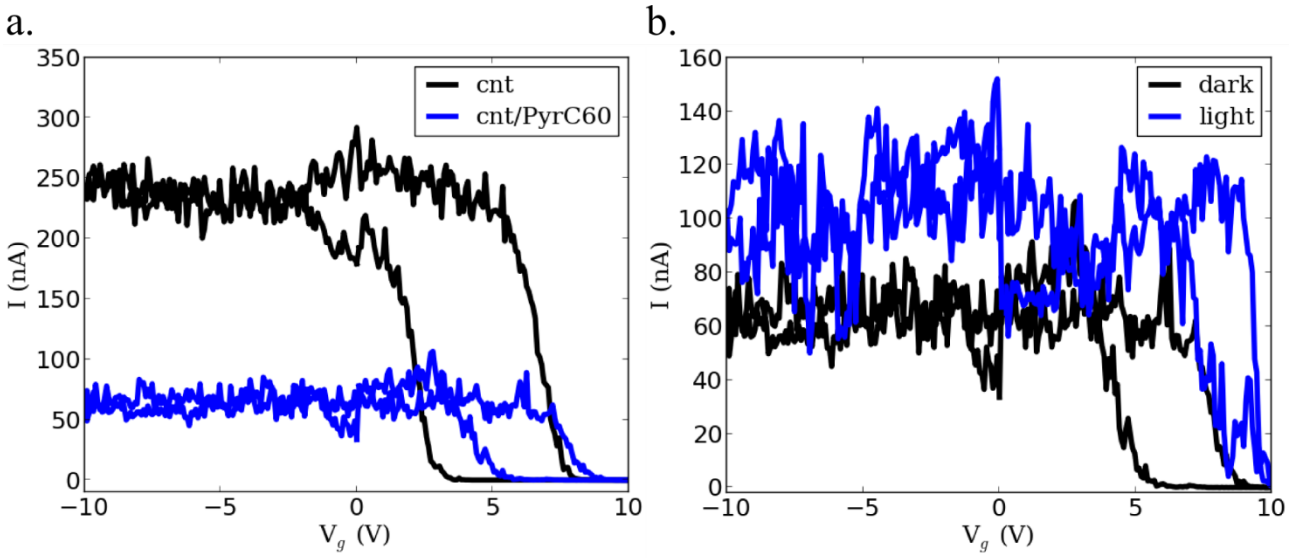

Figure S8.a. Transfer characteristics of a ~ 450 nm CNTFET device measured before (black) and after (blue) functionalization with the Pyr-C$_{60}$ moiety. **c.** The functionalized CNTFET measured in the dark (black) and under illumination (blue).

Figure S7a shows the transfer characteristic of a CNTFET device with channel length of ~450 nm. The pristine device has parameters $V_{th,u}^{p} \sim$ 2.8 V, $\mu_{FE,u}^{p} \sim$ 370 cm^2/Vs, $V_{th,d}^{p} \sim$ 7.6 V, $\mu_{FE,u}^{p} \sim$ 320 cm^2/Vs. The functionalized device has parameters $V_{th,u}^{f} \sim$ 5.5 V, $\mu_{FE,u}^{f} \sim$ 48.0 cm^2/Vs, $V_{th,d}^{f} \sim$ 8.5 V, $\mu_{FE,u}^{f} \sim$ 86 cm^2/Vs.

Figure S7b shows the functionalized 450 nm CNTFET measured in the dark and under illumination by a 150 W halogen lamp. The transfer parameters when measured in the dark are $V_{th,u}^{f,d} \sim$ 5.5 V, $\mu_{FE,u}^{f,d} \sim$ 48 cm^2/Vs, $V_{th,d}^{f,d} \sim$ 8.5 V, $\mu_{FE,u}^{f,d} \sim$ 86 cm^2/Vs. The transfer parameters when measured in the light are $V_{th,u}^{f,l} \sim$8.0 V, $\mu_{FE,u}^{f,l} \sim$ 160 cm^2/Vs, $V_{th,d}^{f,l} \sim$ 9.7 V, $\mu_{FE,u}^{f,l} \sim$ 330 cm^2/Vs. Again, as under illumination the SWCNT/Pry-C$_{60}$ device does not fully reach an 'off' state within the V_g sweep range the extracted FET parameters are somewhat unreliable. The pristine device showed no appreciable change under illumination with the 150 W halogen lamp (figure S4a).