Electronic Supplementary Information (ESI)

Quantum Dot Decorated Aligned Carbon Nanotube Bundles for a Performance Enhanced Photoswitch

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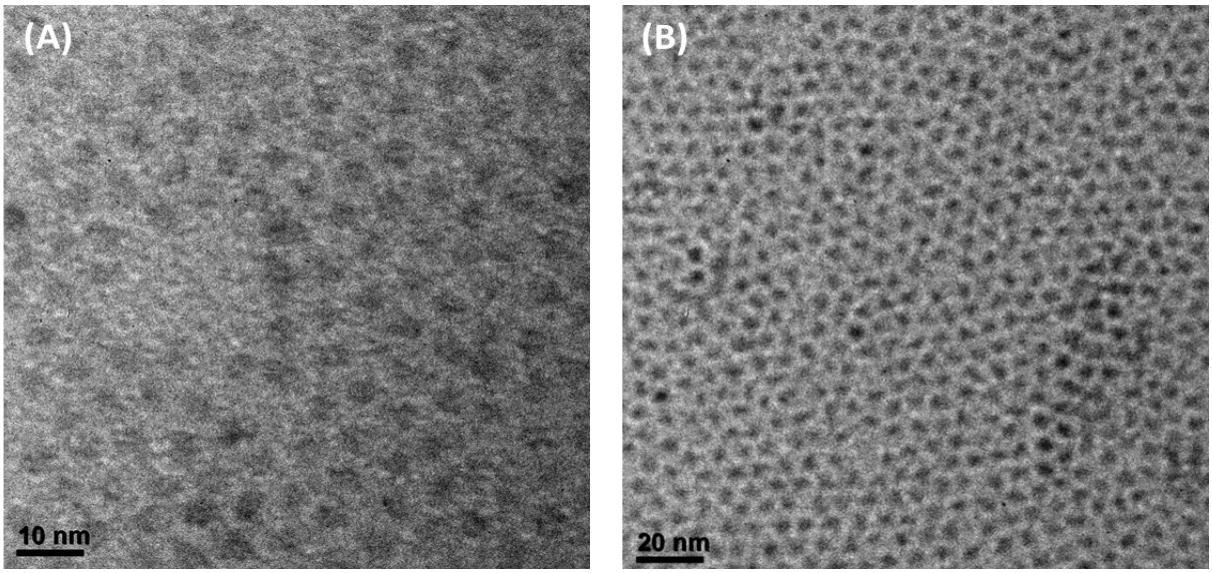

Fig. S1. (A,B) High-resolution TEM images of CdSe QDs indicating the size and morphology.

Absorption spectrum analysis

The plot of $(Ah\nu)^2$ *vs* hν was obtained from absorption spectrum, where A represents the absorbance intensity and ν represents the wavenumber corresponding to the wavelength. The bulk energy bad gap of CdSe is the X-intercept of the linear fit of the data points between the initiation point of the steep rise and the global maximum. The particle size distribution was computed from a theory relating the absorbance intensity and size of particle[22] (formula is given below). This formula is valid when particles are spherical.

$$n(r) = (\text{const} \times (dA/dr)) / (\text{volume of sphere})$$

where r is radius, n(r) is the frequency of particle size, and dA/dr is the slope of absorption spectrum. The size relation of CdSe with wavelength was obtained from literature.[7] The plot of n(r) *vs* r gives the particle size distribution.

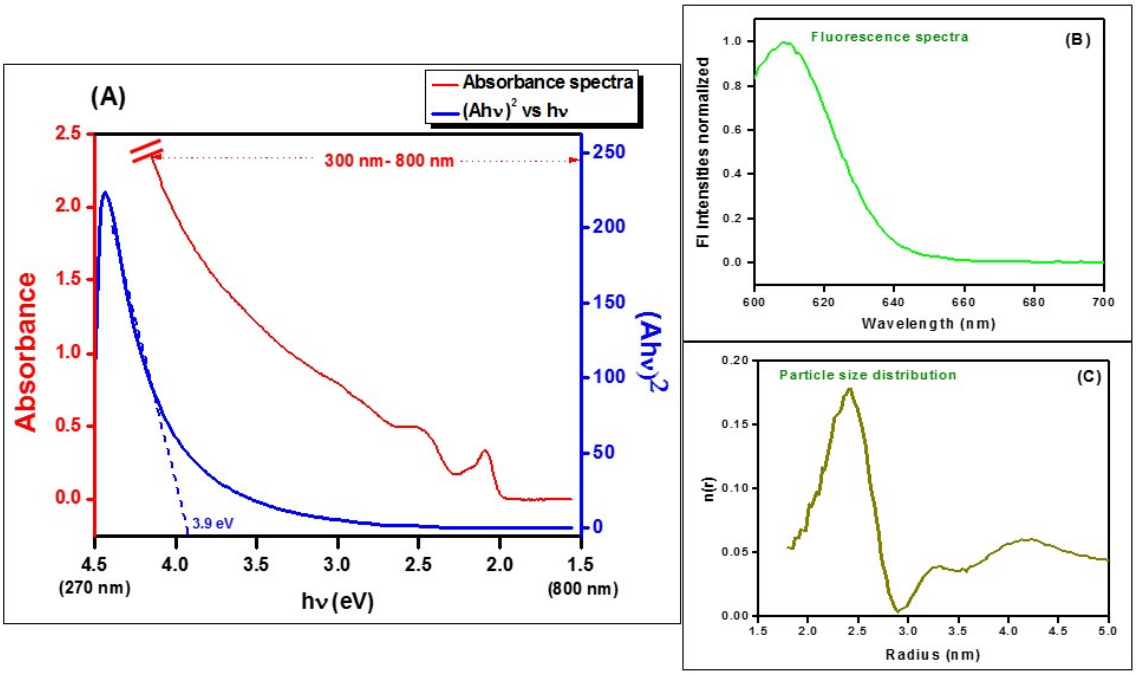

Fig. S2. (A) Absorption spectrum of CdSe QDs (red) and $(Ahν)^2$ *vs* hν plot (blue) to determine the bulk energy gap (E_g) for CdSe (blue dotted line). (B) Fluorescence spectrum of CdSe QDs at excitation (λ_{ex}) wavelength of 514 nm. (C) Particle size distribution plot for CdSe derived from absorption spectrum.

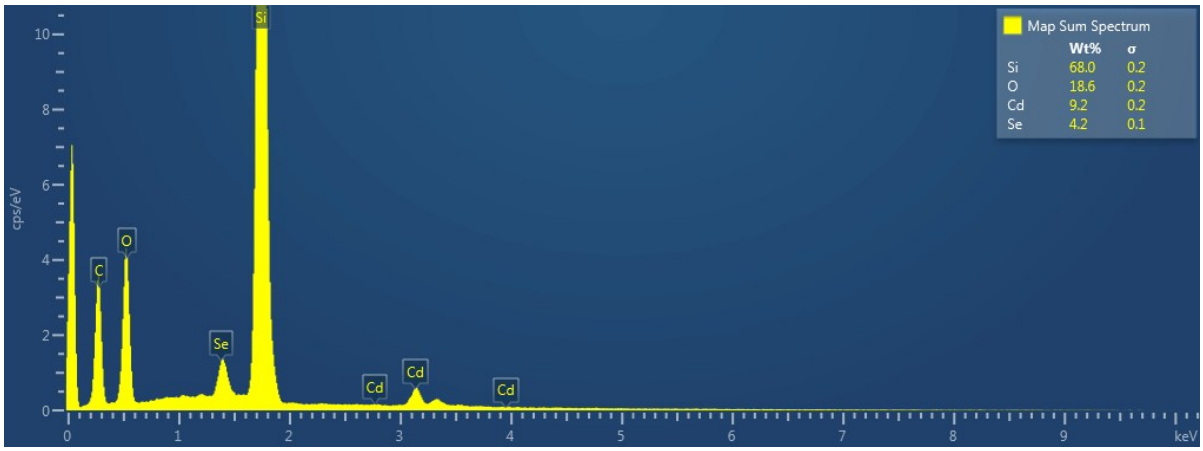

Fig. S3. EDS spectrum of CdSe-MWCNT@PANI indicating the presence of various elements in the device such as carbon, selenium, cadmium, and oxygen. Silicon is the base of the device.

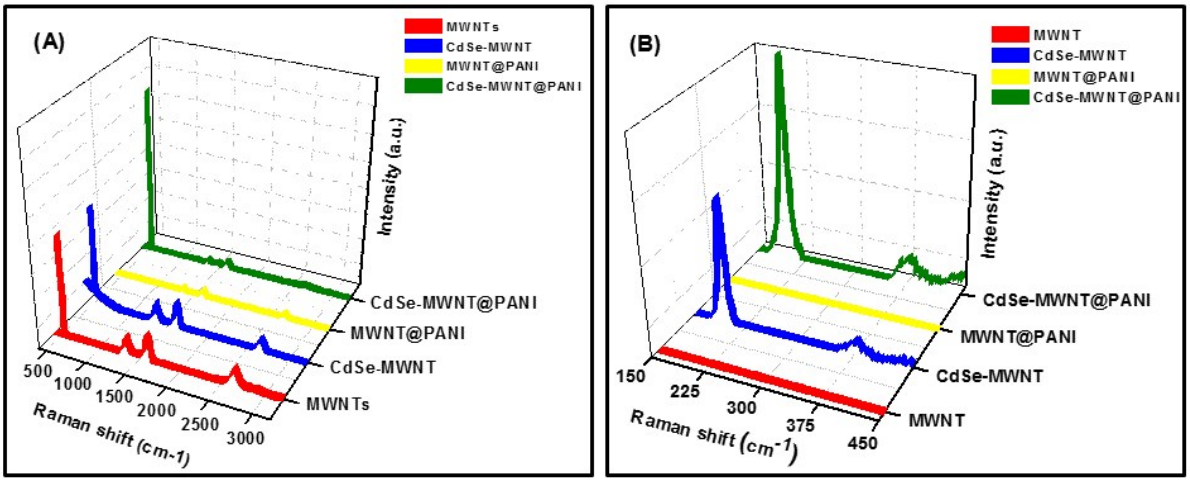

Fig. S4. Raman spectra of (A) MWCNTs, CdSe-MWCNT, MWCNT@PANI and CdSe-MWCNT@PANI in the range 500-3200 cm^{-1} excited at 633 nm, and (B) MWCNTs, CdSe-MWCNT, MWCNT@PANI and CdSe-MWCNT@PANI in the range of 100-450 cm^{-1} excited at 488 nm.

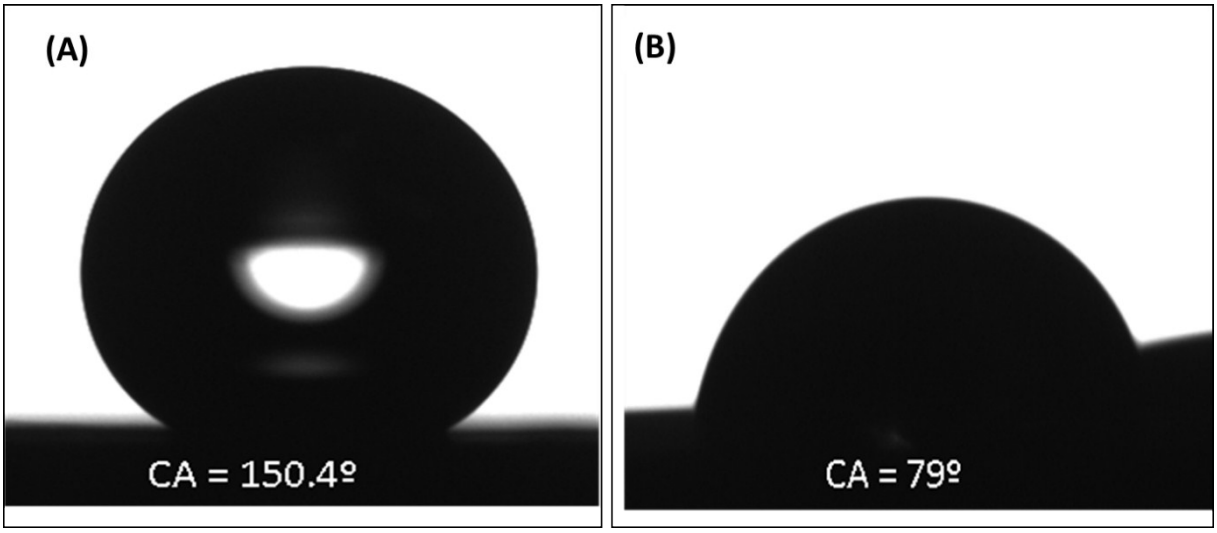

Fig. S5. CCD photographs showing the contact angle measurements of a water drop resting on (A) MWCNTs and (B) MWCNT@PANI.

Electrical parameters of CdSe-MWCNT@PANI

The short circuit current density (J_{sc}) of the device in dark and illuminated conditions was the Y-intercept value of the *J-V* curves (Fig. 3B and 3C respectively). The open circuit voltages (V_{oc}) in these conditions were the X-intercept of the same graphs. The power conversion efficiency was determined by the formula[31] ($FF \times V_{oc} \times I_{sc}$) / P_{in} to be 5.41%. The fill factor was determined as the ratio of the area *J-V* curve in illuminated conditions to the area of the curve obtained from an ideal photovoltaic cell. The shunt resistance was computed from the slope of the *I-V* curve (Fig. 3A) in the low reverse bias region.[37]

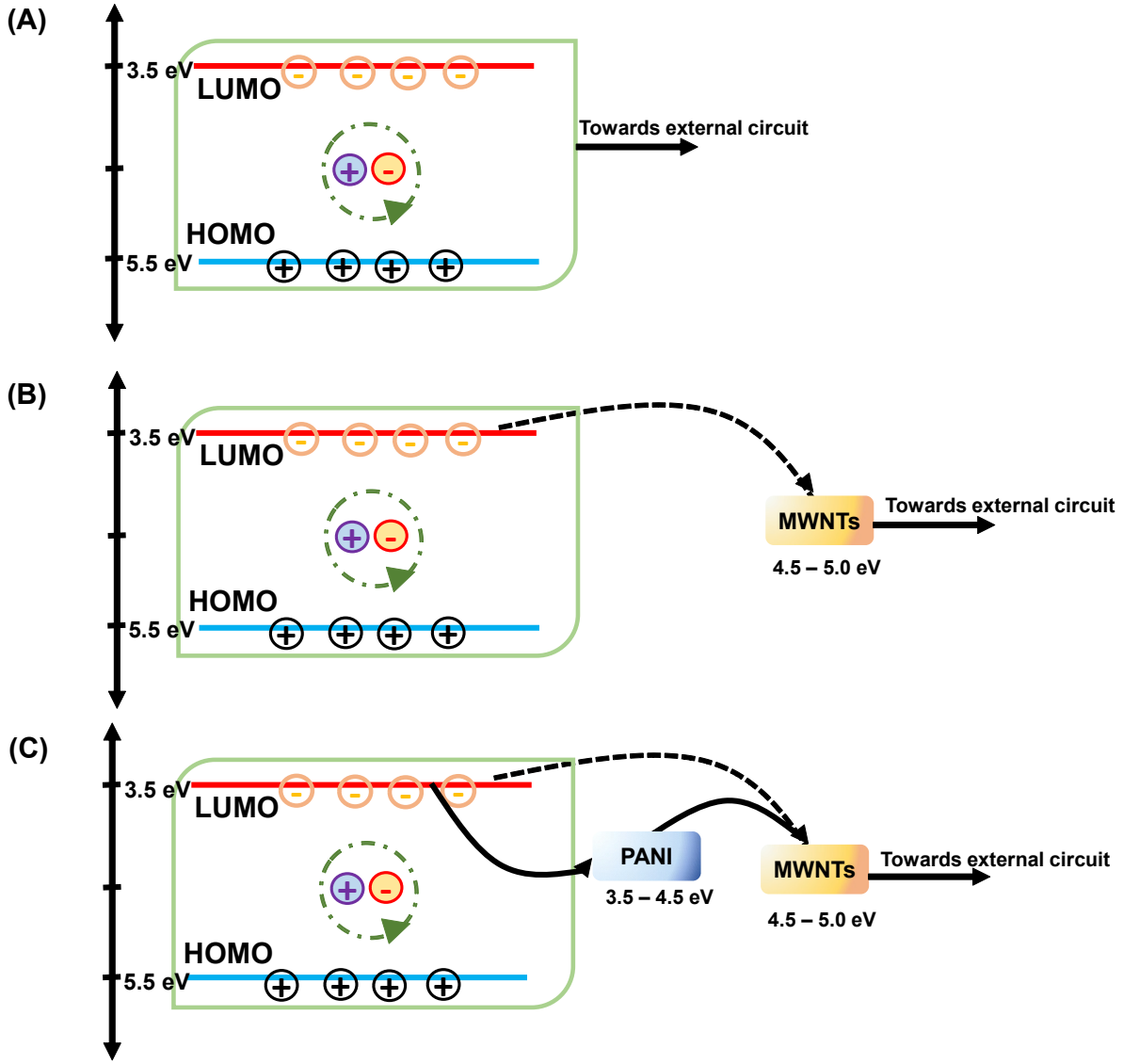

Fig. S6. Charge transfer mechanism occurred within (A) CdSe QDs, (B) photoactive cell containing CdSe and MWCNTs, and (C) photoactive cell based on CdSe-MWCNT@PANI (present device).