Supporting Information

Three-dimensional nanocomposite formed by hydrophobic multiwalled carbon nanotubes threading titanium dioxide for counter electrode of enhanced performance dye-sensitized solar cells

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In our study, we doped TiO_2 with different amount (10%, 20% and 30%) in MWCNTs for the optimum performance of DSSCs. The nanocomposite counter electrode (CE) which contain 20% TiO_2 showed the highest efficiency for DSSCs. The FE-SEM images Fig. S1 (a) & (b) show that the nanocomposite containing 10% TiO_2 threaded by MWCNTs have not tightly assembled. Furthermore, Fig. S1(c) & (d) exhibit that the TiO_2 nanoparticle dispersed irregularly. The power conversion performances of our as-prepared samples (10%, 20% and 30%) are shown in Fig. S2 and their corresponding photovoltaic parameters are tabulated in Table S1. Fig. S3(a) presents a FE-SEM image of the pristine MWCNTs which were applied for building 3D threaded architectures. The diameter and length was found to be 30-50 nm and 10-20 μm, respectively. The surface morphology of our synthesized TiO_2 was shown in Fig. S3(b) and its diameter is 25 nm. As shown in Fig. 3(c) & 3(d), the film thickness of photoanode and our nanocomposite CE (20% TiO_2) were found to be 13.70 μm and 11.95 μm respectively. Fig. S4 is EDX mapping to characterize the distribution of various elements in nanocomposite. Fig. S5 depicts the lower peak-to-peak separation (E_{pp}) value of our as-prepared (MWCNTs/TiO_2) CE than MWCNTs and conventional

Pt CE. The obtained results indicate excellent catalytic reversibility towards the reduction of I_3^- due to the introduction of TiO_2 into MWCNTs. The BET surface area (114.05334 m^2/g) and the nitrogen adsorption isotherms of pristine MWCNTs were measured (See in Fig. S6) by a N_2 adsorption isotherm at 77 K with a BET analyzer (JW-BK122W, Beijing JWGB Sci.&Tech.Co.,Ltd.).

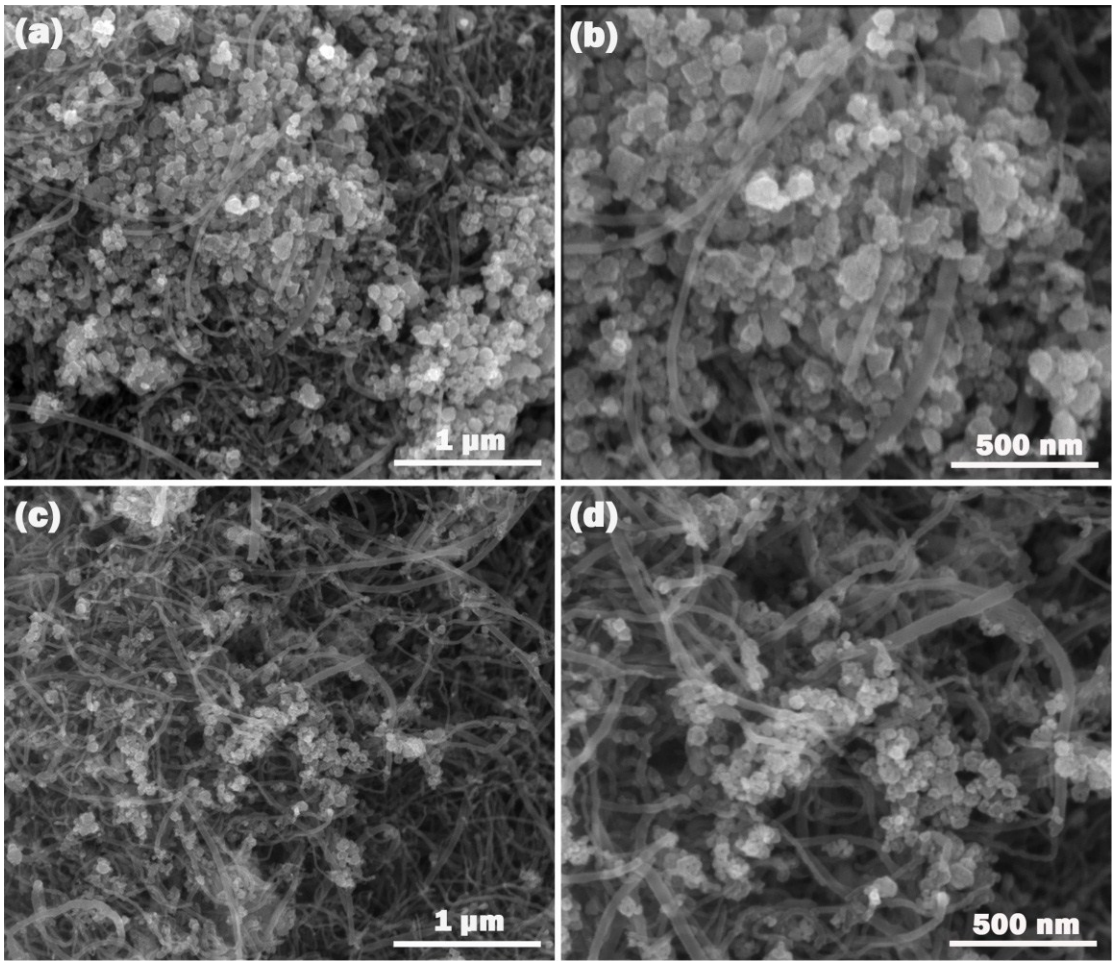

Figure S1. SEM images of (a) 10% TiO_2 and (b) the high resolution image of 10% TiO_2. (c) 30% TiO_2 and (d) the high resolution image of 30% TiO_2.

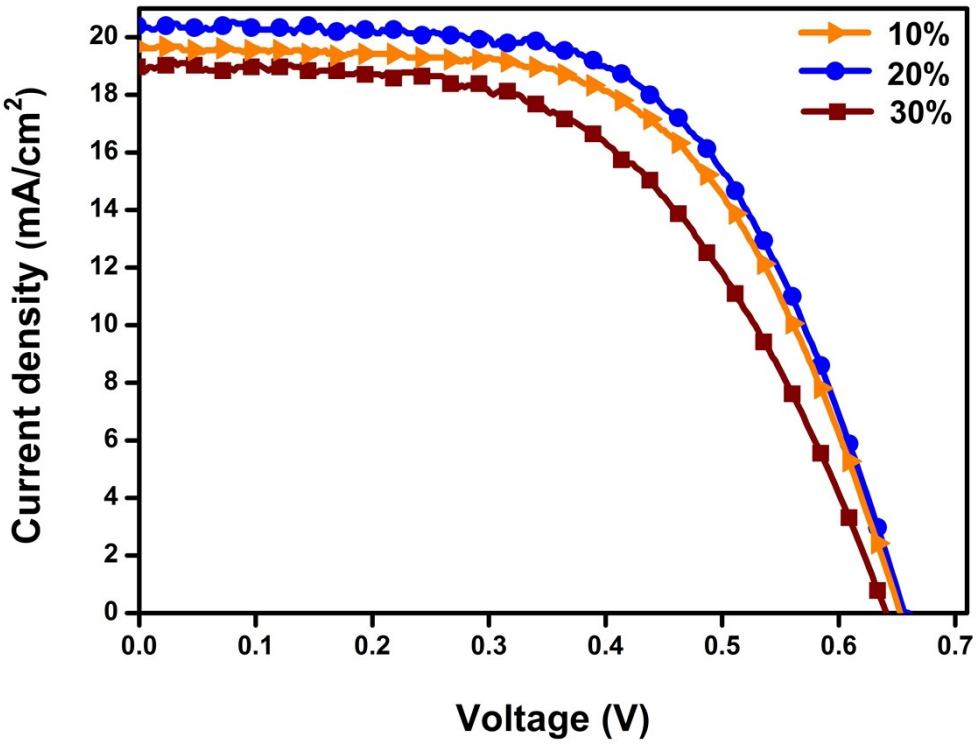

Figure S2. J-V curves for nanocomposite CEs with different percentage of TiO_2.

Table S1. Photovoltaic performance of nanocomposite CEs with different percentage of TiO_2.

Percentage	J_{sc}(mA/cm^2)	V_{oc} (V)	FF	PCE (%)
10%	19.5	0.66	0.58	7.56
20%	20.1	0.66	0.60	7.95
30%	18.9	0.64	0.55	6.61

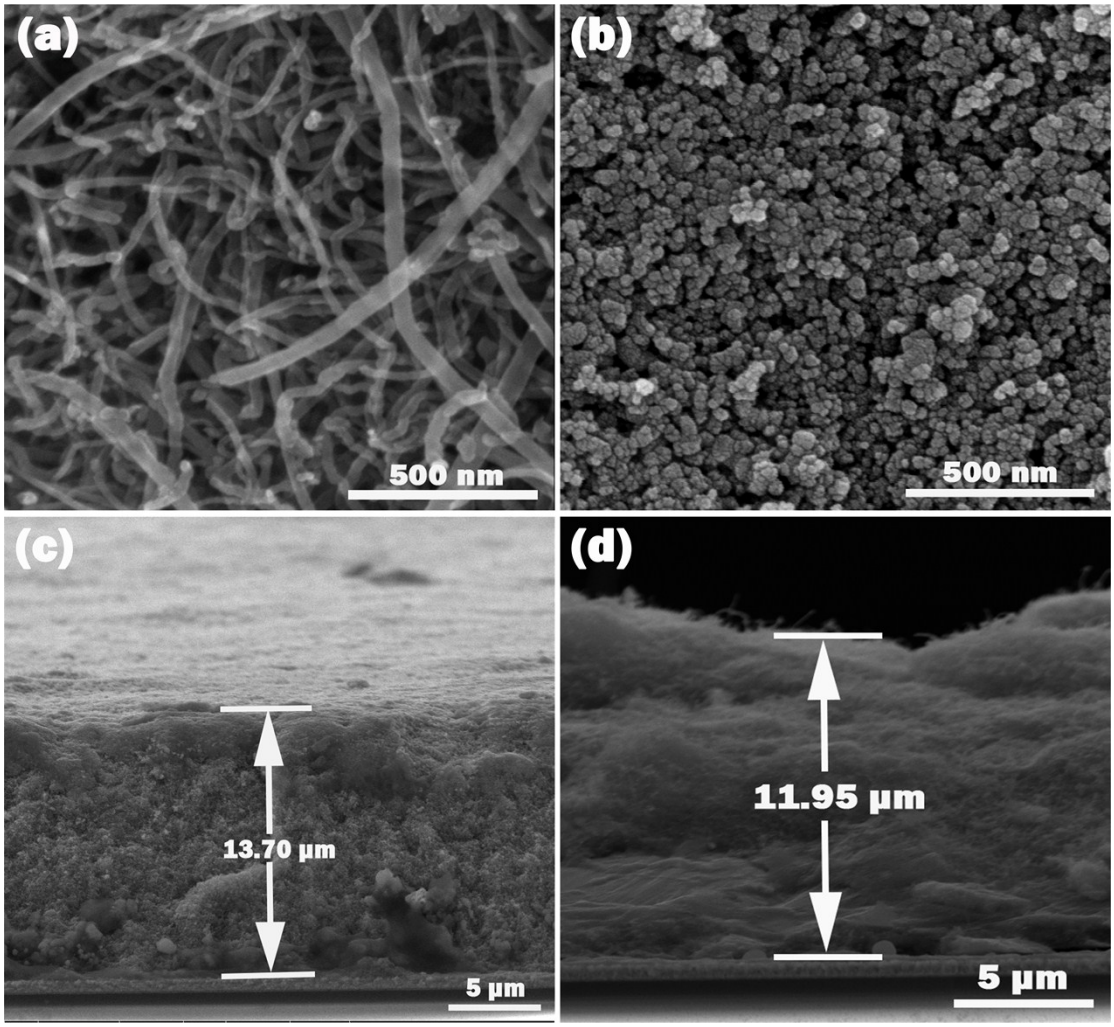

Figure S3. SEM images of (a) MWCNTs (b) TiO_2 synthesised by hydrothermal method (c) thickness of photoanode for DSSCs. (d) thickness of nanocomposite CE fabricated with the method of doctor-blading.

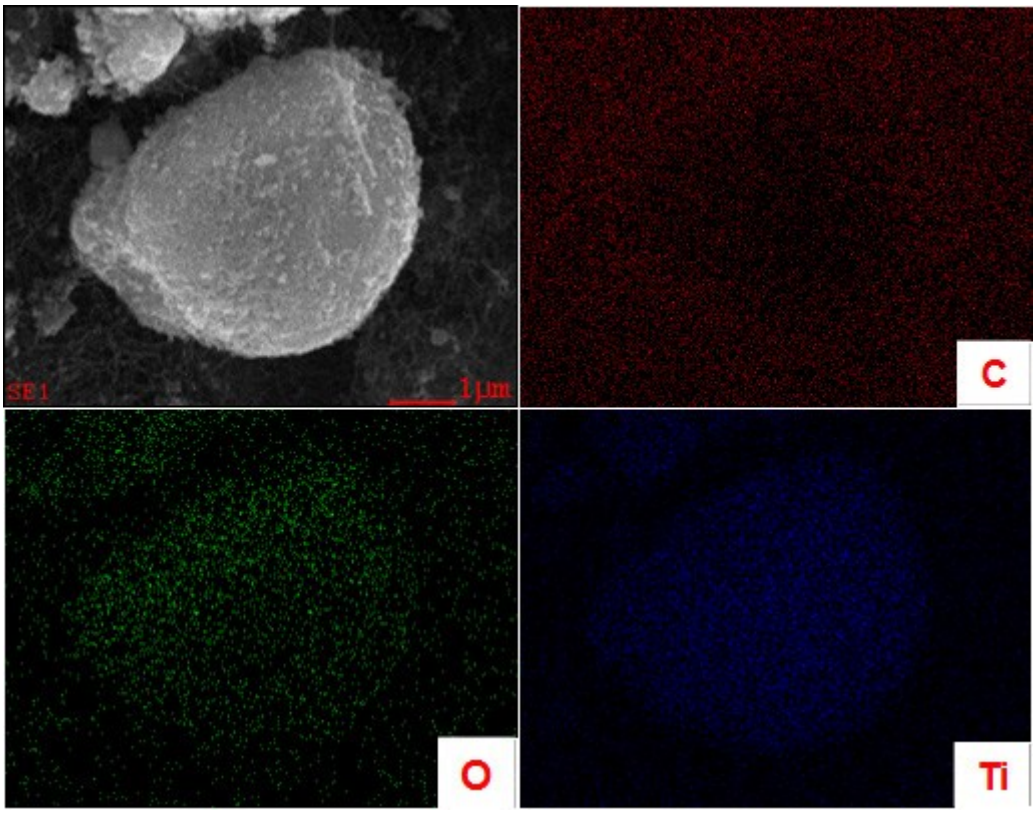

Figure S4. EDX mapping images for selected assembly of nanocomposite.

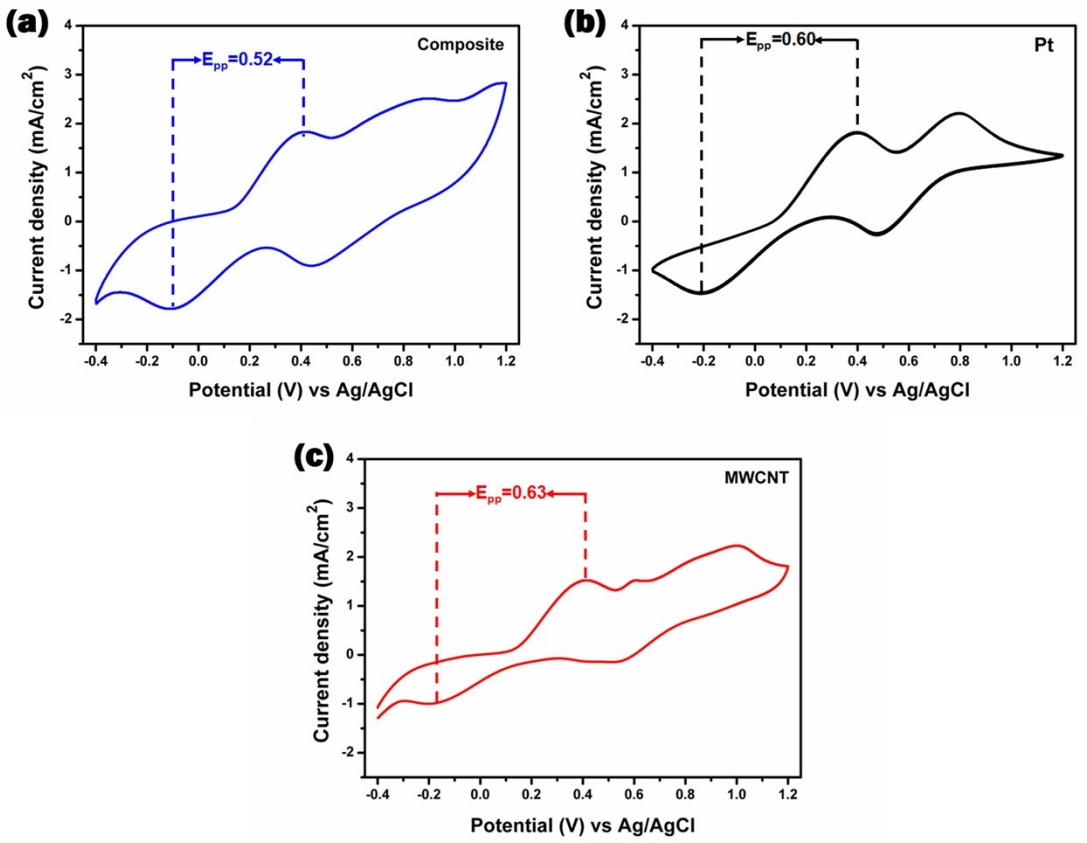

Figure S5. Cyclic voltammetry (CV) curves (peak-to-peak separation).

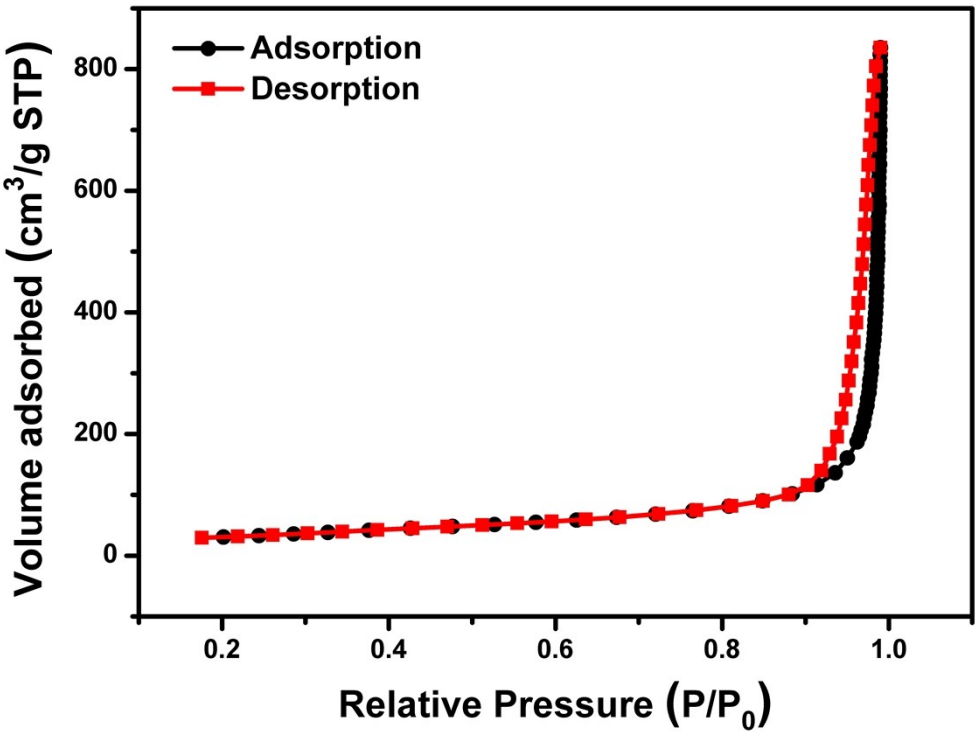

Figure S6. Nitrogen adsorption isotherms of pristine MWCNTs.