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# Supporting Information

## An Evidence for Organic N-Doped Multiwall Carbon Nanotube Heterostructure and its Superior Electrocatalytic Properties for Promising Dye-Sensitized Solar Cell

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**Table S1.** CV parameters of MWCNT electrode dispersed with a different dispersant.

| Type of Dopant | Cathodic Voltage (V) | Cathodic current density ($I_{PC}$) (mA. $Cm^{-2}$) | Peak- to-Peak ($E_{PP}$) (V) |
|---|---|---|---|
| SDS | -0.05 | -0.63 | 0.43 |
| Biotin | -0.04 | -1.12 | 0.52 |
| BSA | -0.03 | -1.45 | 0.41 |

**Table S2.** CV parameters of MWCNT electrode dispersed with Serum bovine albumin (BSA) dispersant at different pH.

| pH of BSA Dopant | Cathodic Voltage (V) | Cathodic current density ($I_{PC}$) (mA. $Cm^{-2}$) | Peak- to-Peak ($E_{PP}$) (V) |
|---|---|---|---|
| 3 | -0.10 | -3.83 | 0.44 |
| 5 | -0.06 | 1.94 | 0.43 |
| 7 | -0.03 | -1.45 | 0.41 |
| 9 | -0.05 | -1.19 | 0.42 |
| 11 | -0.05 | -0.75 | 0.42 |

**Table S3.** CV parameters of Pt and organic N-doped MWCNT heterostructure.

| Counter electrode | Cathodic Voltage (V) | Cathodic current density ($I_{PC}$) (mA. $Cm^{-2}$) | Peak- to-Peak ($E_{PP}$) (V) |
|---|---|---|---|
| Pt | -0.24 | -1.16 | 0.31 |
| Organic N-doped MWCNT | -0.10 | -3.83 | 0.44 |

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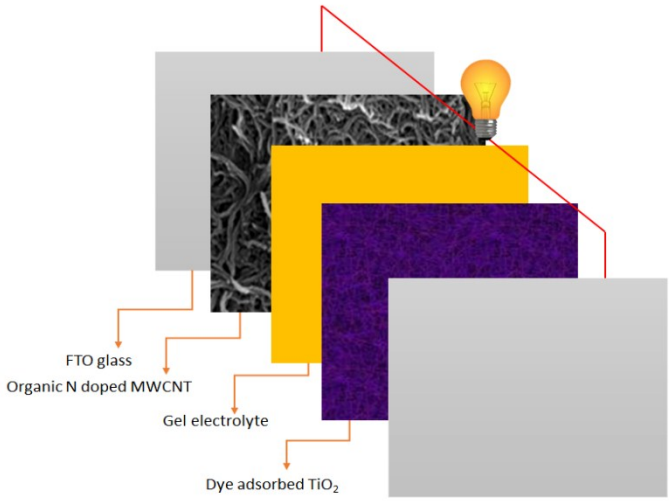


**Figure S1.** Schematic illustration of proposed DSSC structure with fabricated with organic N- doped MWCNT heterostructure cathode.

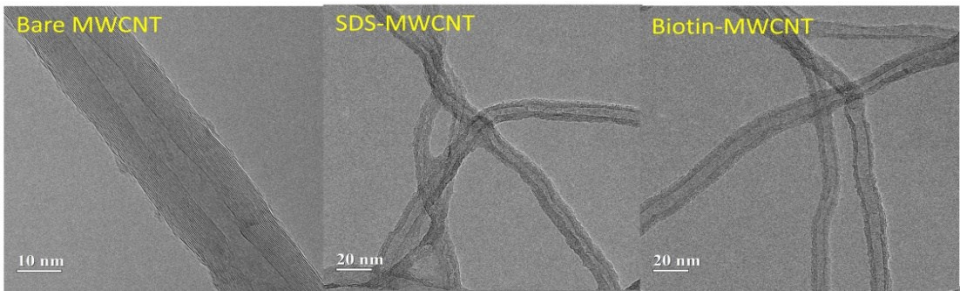


**Figure S2.** TEM images of bare MWCNT, SDS treated MWCNT and Biotin treated MWCNT structure.

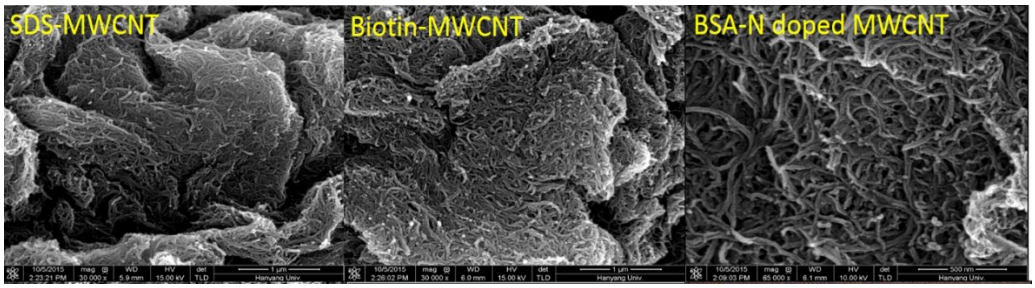


**Figure S3.** FE-SEM images of SDS treated MWCNT, Biotin treated MWCNT and BSA treated MWCNT structures

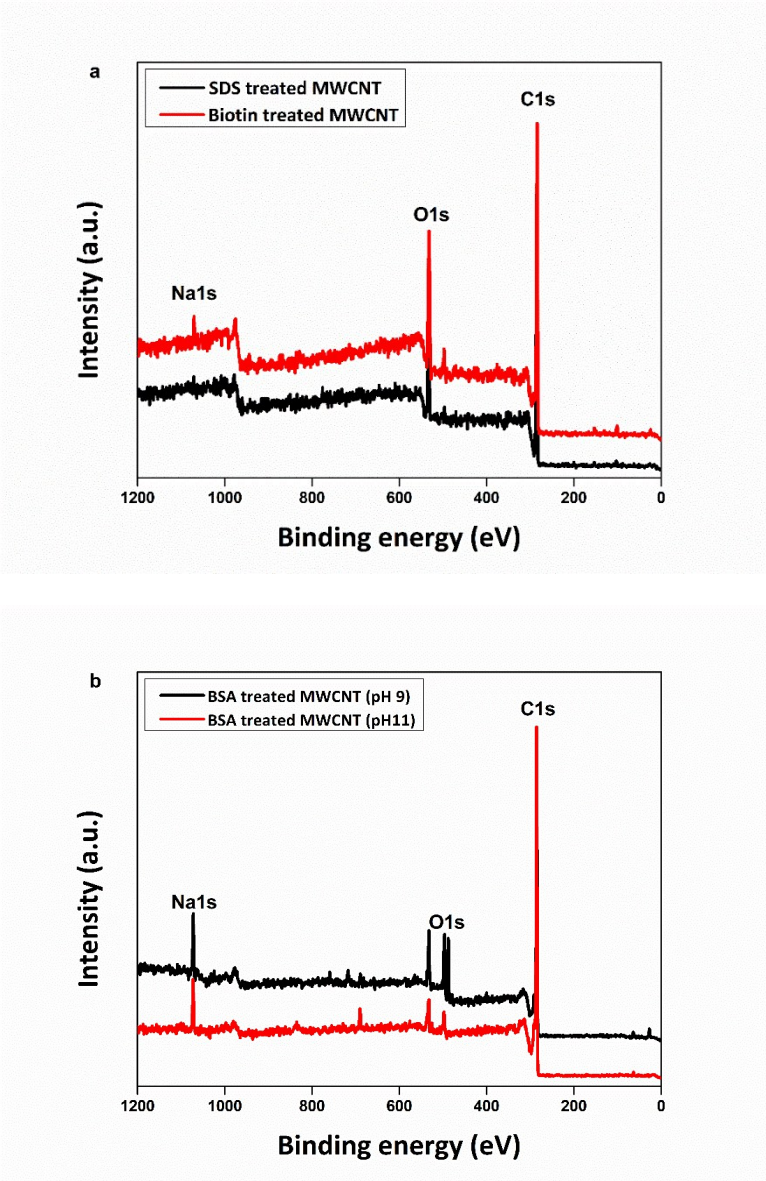


**Figure S4** XPS analysis of MWCNT treated with (a) SDS and bition dispersants, (b) BSA at alkaline pH.

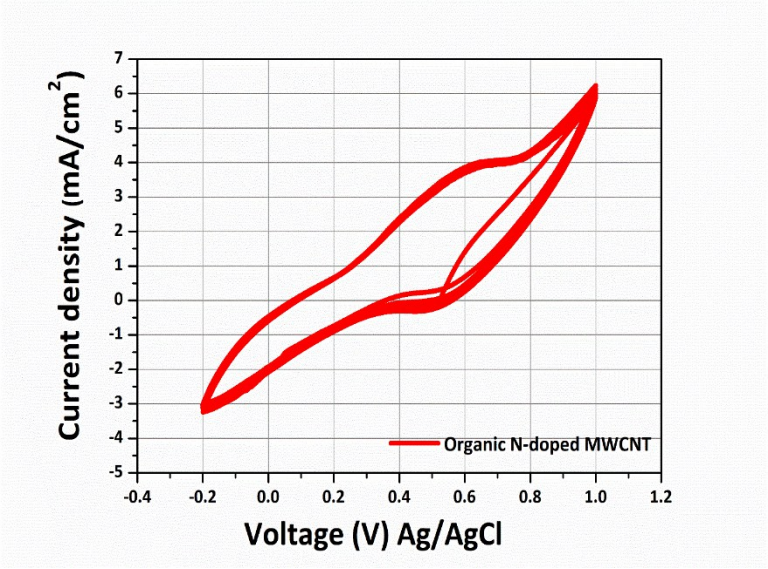


**Figure S5** Cyclic stability of organic N doped MWCNT heterostructure.

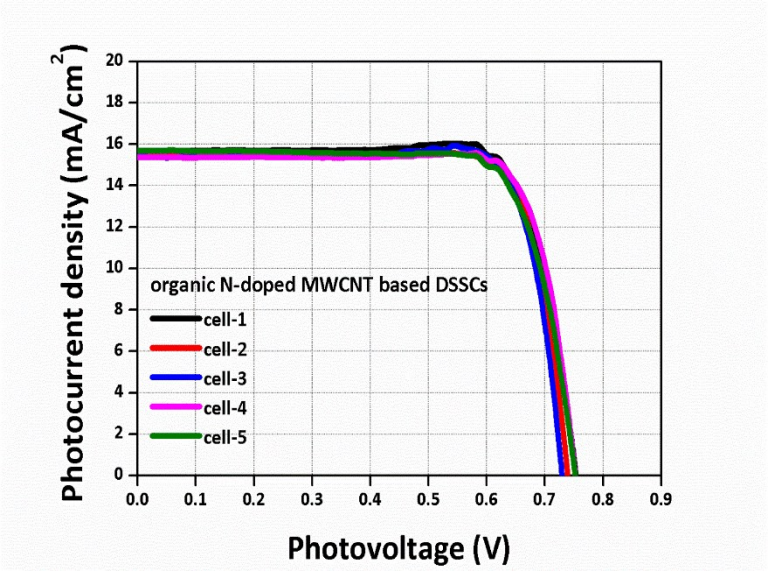


**Figure S6** stability test of DSSC performance fabricated with of organic N-doped MWCNT heterostructure.

**Table S4.** Stability test of DSSCs performance fabricated with organic N-doped MWCNT counter electrode.

| Cells | Complete DSSC | | | |
|---|---|---|---|---|
| | $J_{SC}$ (mA.cm$^{-2}$) | $V_{OC}$ (V) | FF (%) | PCE (%) |
| **Cell-1** | 15.681 | 0.753 | 80.84 | 9.55 |
| **Cell-2** | 15.415 | 0.739 | 81.03 | 9.23 |
| **Cell-3** | 15.402 | 0.729 | 82.81 | 9.30 |
| **Cell-4** | 15.375 | 0.752 | 81.84 | 9.47 |
| **Cell-5** | 15.700 | 0.752 | 78.38 | 9.26 |

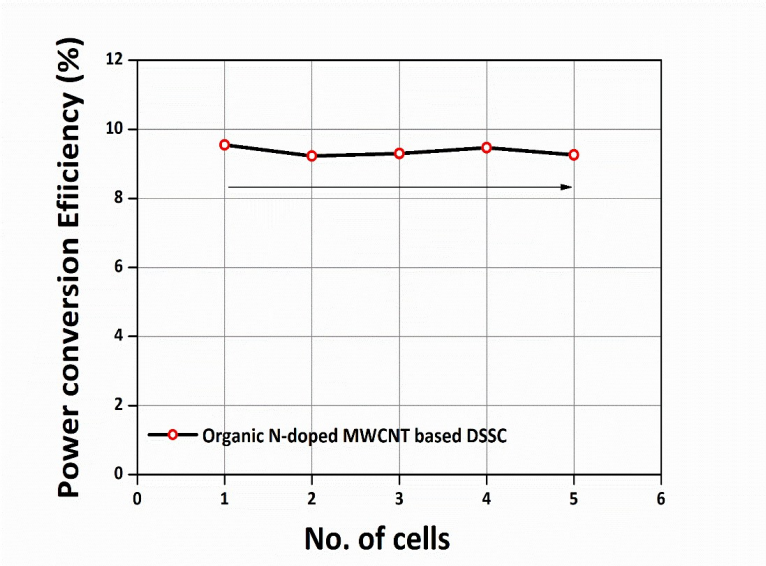


**Figure S7** photovoltaic performance of DSSC fabricated with organic N-doped MWCNT heterostructure counter electrode.