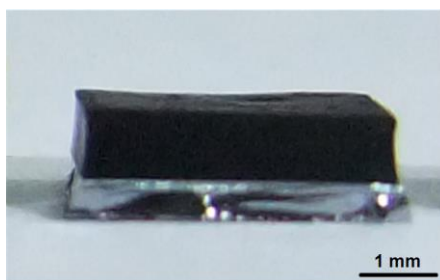


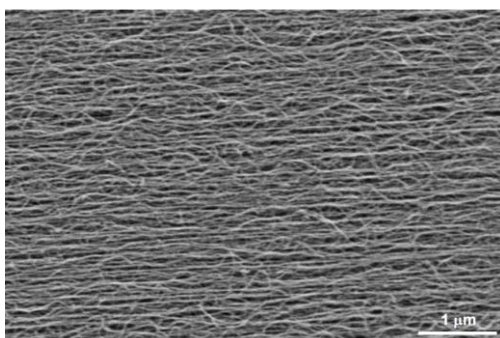
## Supporting Information

### Experimental section

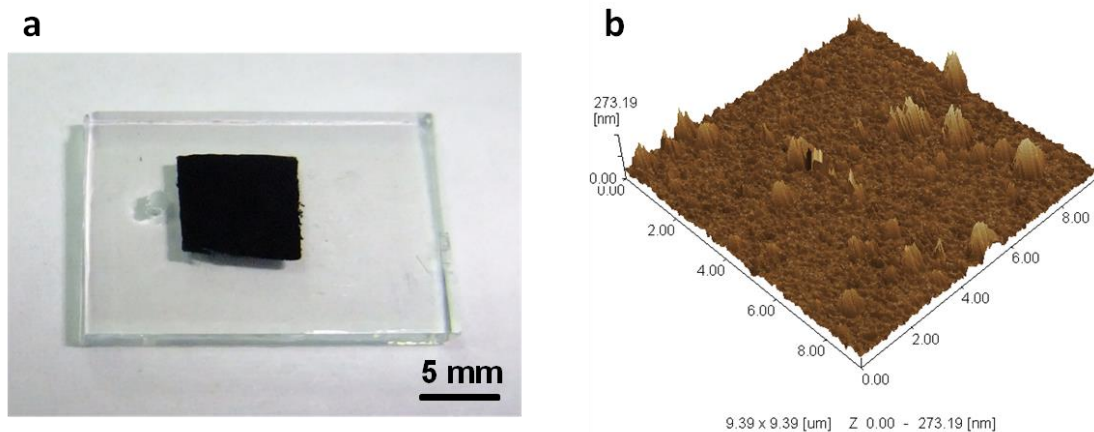
Fluorine-doped tin oxide conductive glass was obtained from Nippon Sheet Glass Co., Japan. Poly (ethylene naphthalate) was obtained from Peccell Co., Japan. Titanium dioxide slurry (DHS-TPP3 and DHS-TPP200, Hydrothermal titanium dioxide dispersion phase of terpinol) and powder (DHS-SN1760-500) were obtained from Dalian Heptachroma Solartech Co., Ltd.



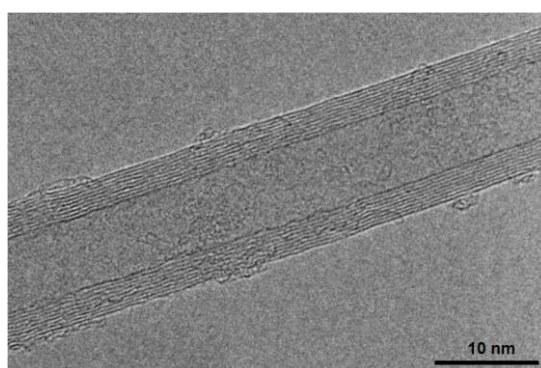
**Figure S1.** Photograph of a typical CNT array with thickness of  $\sim 0.8$  mm.



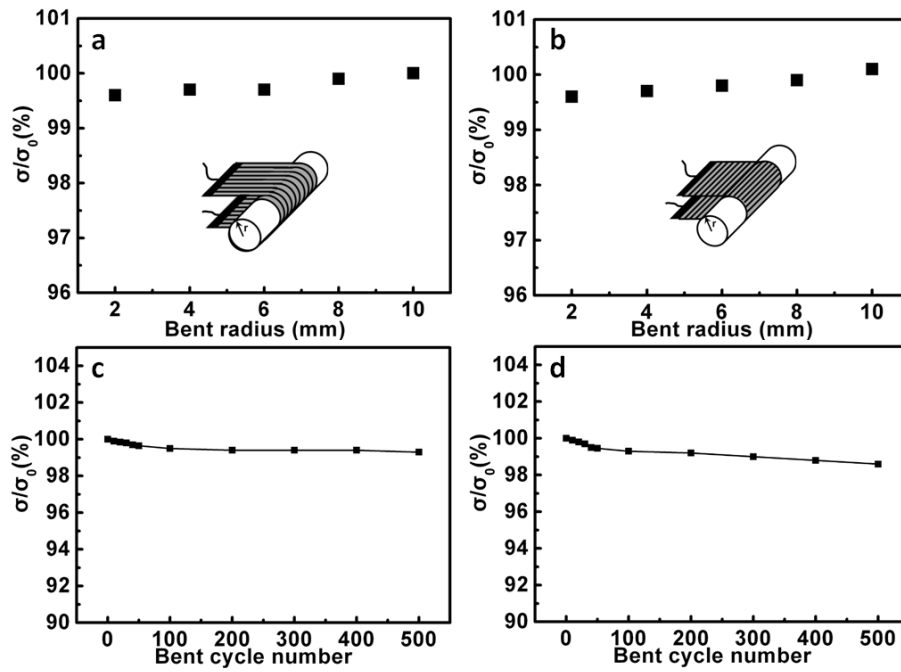
**Figure S2.** Scanning electron microscopy image of the CNT film from a top view.



**Figure S3.** **a.** Photograph of a CNT film on fluorine-doped tin oxide glass. **b.** Atomic force microscopy image of the top surface of the CNT film at **a.**



**Figure S4.** High-resolution transmission electron microscopy image of a CNT.



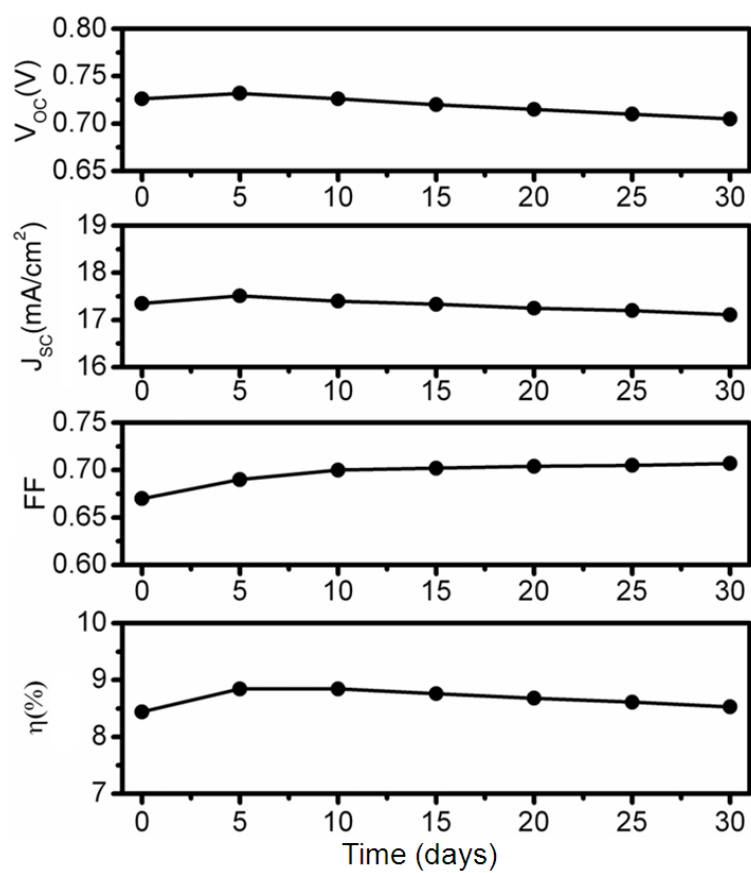
**Figure S5.** Electrical conductivities of penetrated and aligned CNT films. **a** and **b**. Dependence of electrical conductivity on bent radius in parallel and perpendicular directions relative to the rolling direction, respectively. **c** and **d**. Dependence of electrical conductivity on bent cycle number in parallel and perpendicular directions relative to the rolling direction, respectively. Here one bent cycle means that a CNT film is bent to  $180^\circ$  with bent radius of 4 mm and then recovered to the original state.  $\sigma_0$  and  $\sigma$  correspond to the electrical conductivities of CNT film before and after bending, respectively.

**Table S1.** Photovoltaic parameters of dye-sensitized solar cells by using CNT films with different thicknesses and Pt film as counter electrodes under AM1.5 illumination.

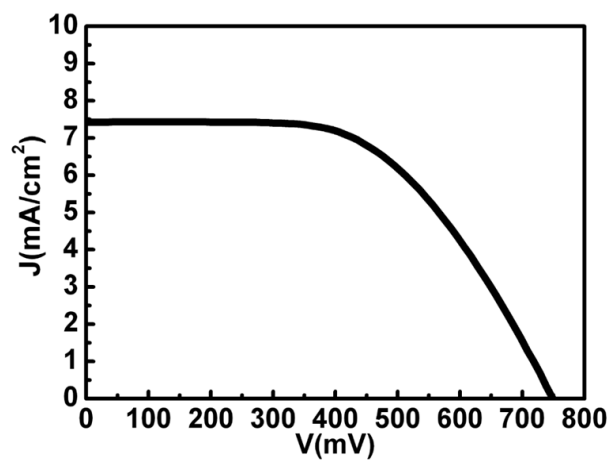
| Counter electrode | V <sub>OC</sub> (mV) | J <sub>SC</sub> (mA/cm <sup>2</sup> ) | FF   | η (%) |
|-------------------|----------------------|---------------------------------------|------|-------|
| CNT film (~10 μm) | 732                  | 13.75                                 | 0.64 | 6.46  |
| CNT film (~20 μm) | 725                  | 15.23                                 | 0.68 | 7.50  |
| CNT film (~30 μm) | 726                  | 17.35                                 | 0.67 | 8.46  |
| CNT film (~40 μm) | 721                  | 17.11                                 | 0.68 | 8.39  |
| Pt film           | 735                  | 16.66                                 | 0.60 | 7.32  |

**Table S2.** Photovoltaic parameters of dye-sensitized solar cells by using CNT film with thickness of ~30 μm and Pt film as counter electrodes under AM1.5 illumination with different light intensities. P<sub>in</sub> corresponds to the incident intensity of AM1.5 solar light.

| Counter electrode | P <sub>in</sub> (mW/cm <sup>2</sup> ) | V <sub>OC</sub> (mV) | J <sub>SC</sub> (mA/cm <sup>2</sup> ) | FF   | η (%) |
|-------------------|---------------------------------------|----------------------|---------------------------------------|------|-------|
| CNT film          | 100                                   | 721                  | 17.25                                 | 0.67 | 8.33  |
| CNT film          | 50                                    | 701                  | 8.99                                  | 0.72 | 9.05  |
| CNT film          | 10                                    | 620                  | 1.74                                  | 0.78 | 8.40  |
| Pt film           | 100                                   | 737                  | 16.32                                 | 0.61 | 7.28  |
| Pt film           | 50                                    | 717                  | 8.67                                  | 0.67 | 8.27  |
| Pt film           | 10                                    | 631                  | 1.57                                  | 0.74 | 7.37  |



**Figure S6.** Evolution of photovoltaic parameters with time for the cell based on penetrated and aligned CNT film as counter electrode under AM1.5 illumination. The thickness of used CNT film is  $\sim 30 \mu\text{m}$ .



**Figure S7.** Typical J-V curve of a flexible dye-sensitized solar cell by using the penetrated and aligned CNT film as counter electrode measured under AM1.5 illumination. The thickness of CNT film was  $\sim 30 \mu\text{m}$ .