Supporting Information

Experimental Section

Carbon nanotube (CNT) arrays could be easily synthesized by a chemical vapor deposition in a quartz tube furnace with a diameter of 2 inches. In a typical synthesis, Fe (1.2 nm)/Al_2O_3 (5 nm) (deposited by electron-beam evaporation method) on silicon wafer was used as the catalyst, ethylene was used as carbon source with a flowing rate of 90 sccm, a mixture of Ar (480 sccm) and H_2 (30 sccm) gases was used as carrying gas, and the reaction was carried out at 750 ^oC. Pure CNT fibers were then spun from the arrays. The thickness of a spinnable CNT array was about 250 μm. Figure S2 shows an optical micrograph of the spinning process through a rotating microprobe. The rotation speed of the microprobe was 2000 rad min^{-1} during the fiber spinning. A CNT fiber may have a tunable diameter of several to tens of micrometers by varying the width of the ribbon end prior to spinning and the rotating speed of the probe. The CNT fiber was ultra-light with a density of 1 μg cm^{-3}, and its linear density was calculated to be 10 μg m^{-1}, compared with 10 mg m^{-1} for cotton and 20-100 mg m^{-1} for wool yarn (*Science* 2004, 306, 1358). The specific strength and stiffness are calculated to be much higher than the strongest and stiffest engineering fibers of *T1000* and *M70J*, respectively (*Science* 2007, *318*, 1892; *Adv. Mater.* 2007, *19*, 4198).

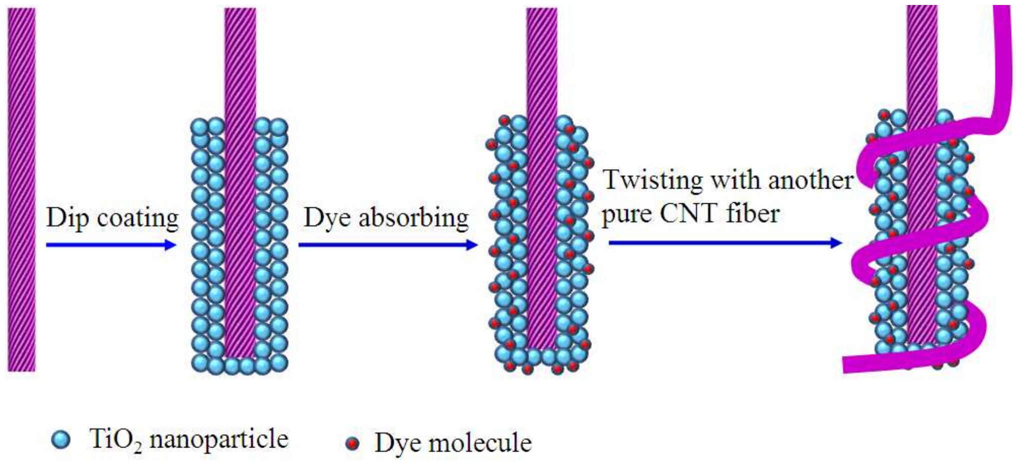

Figure S1. Schematic illustration to the assembly of a wire solar cell based on two CNT fibers.

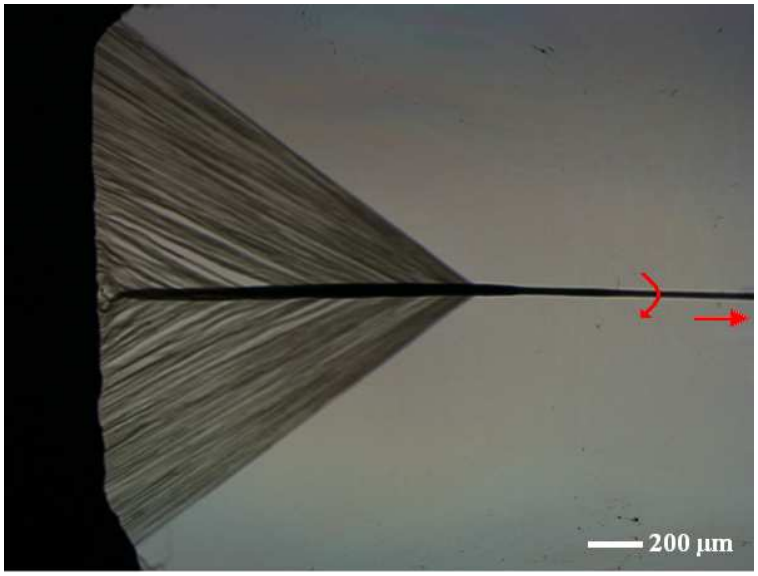

Figure S2. Preparation of a CNT fiber spun from a CNT array through a rotating probe. The left curved arrow showed the rotating direction when the fiber was pulled out of the array along the direction shown by the right arrow.

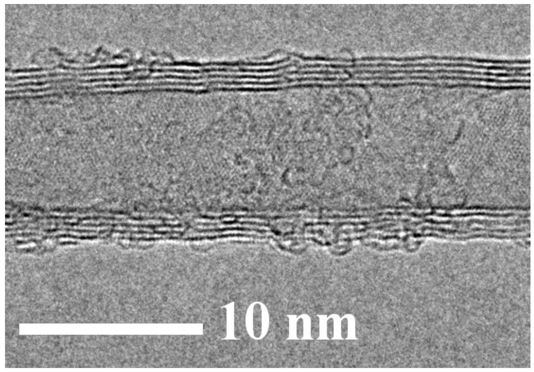

Figure S3. High-resolution transmission electron microscopy image of a CNT with multi-walled structure.

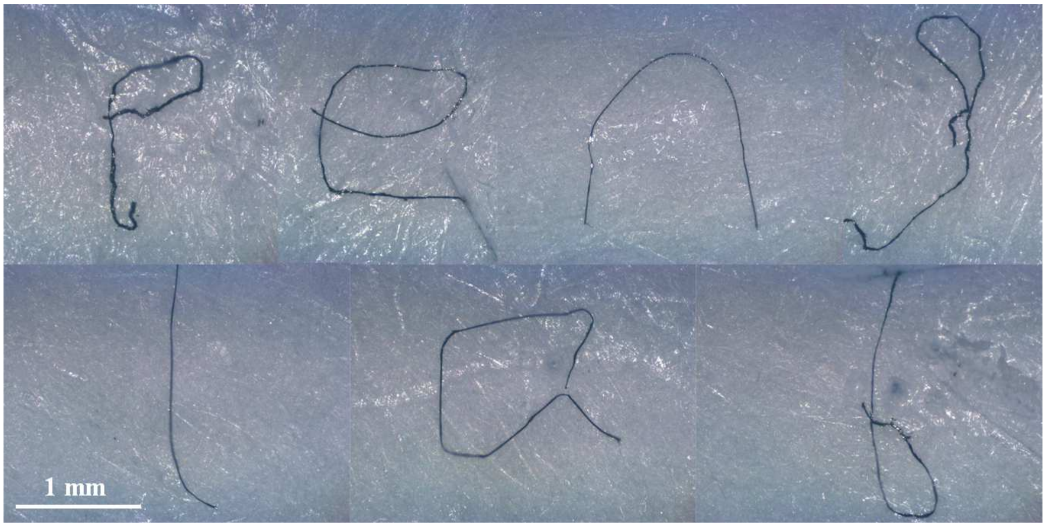

Figure S4. Flexible CNT fibers being bent and folded to form two words of “Peng” at the top and “lab” at the bottom.

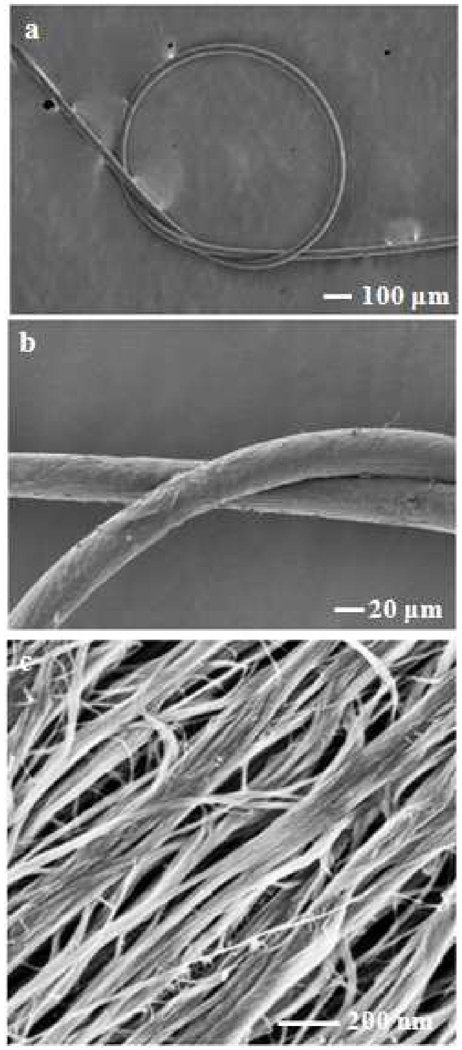

Figure S5. Scanning electron microscopy images of a CNT fiber during the bending.

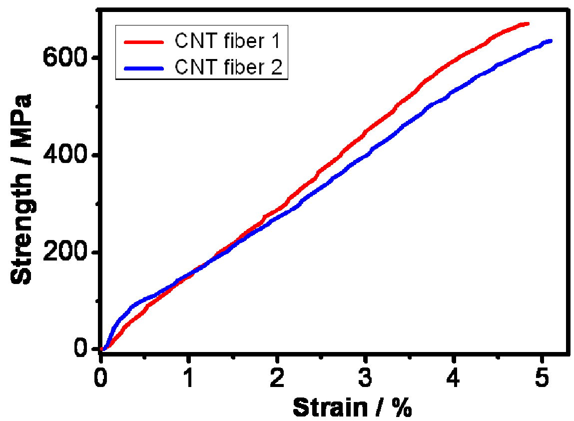

Figure S6. Typical stress-strain curves of two CNT fibers with diameter of 20 μm without any treatment.

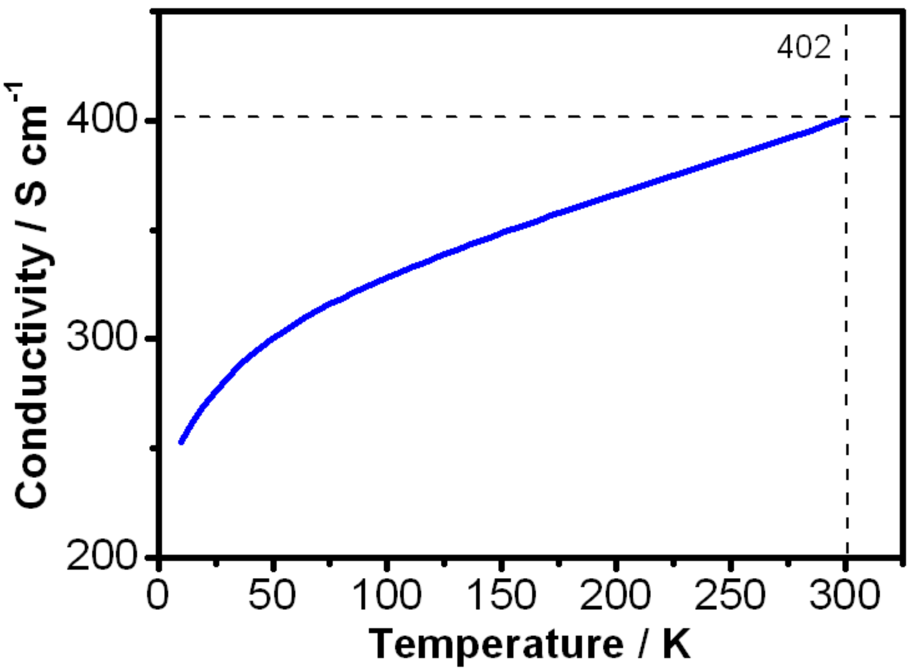

Figure S7. The dependence of electrical conductivity on temperature of a CNT fiber measured by a four-probe method (Reference: *Adv. Mater.* **2011**, *23*, 4620).

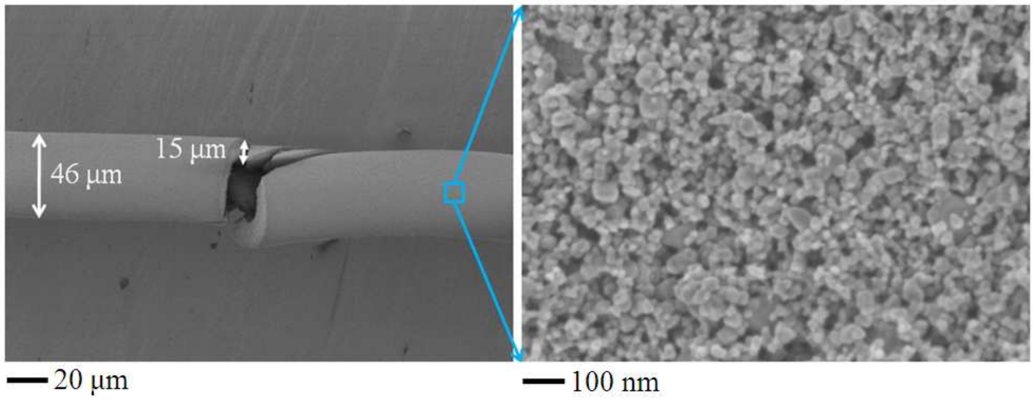

Figure S8. SEM images of a TiO_2 nanoparticle-coated CNT fiber.

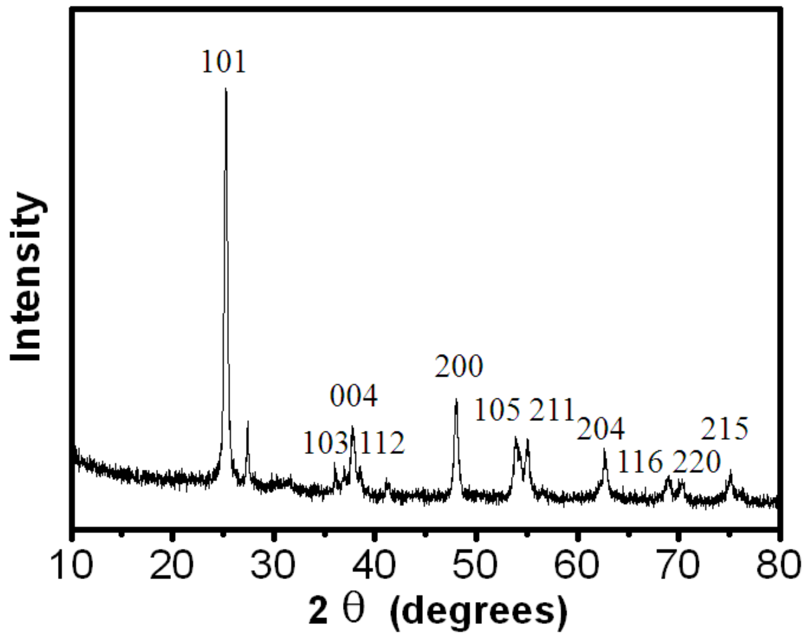

Figure S9. XRD pattern of as-prepared TiO_2 nanocrystals after sintering at 450 ^{o}C.

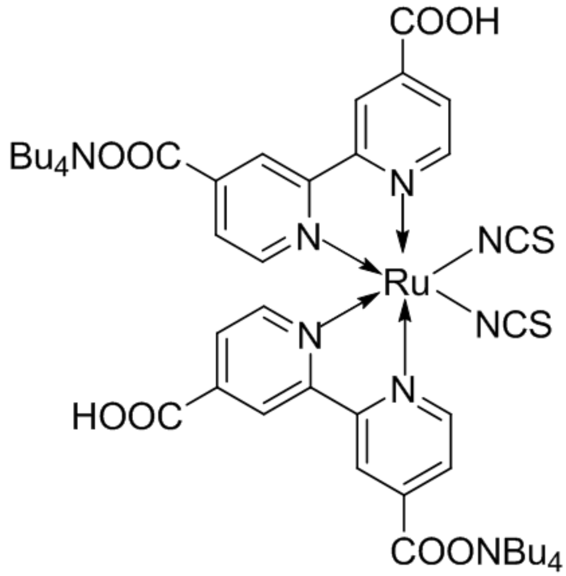

Figure S10. Chemical structure of N719.

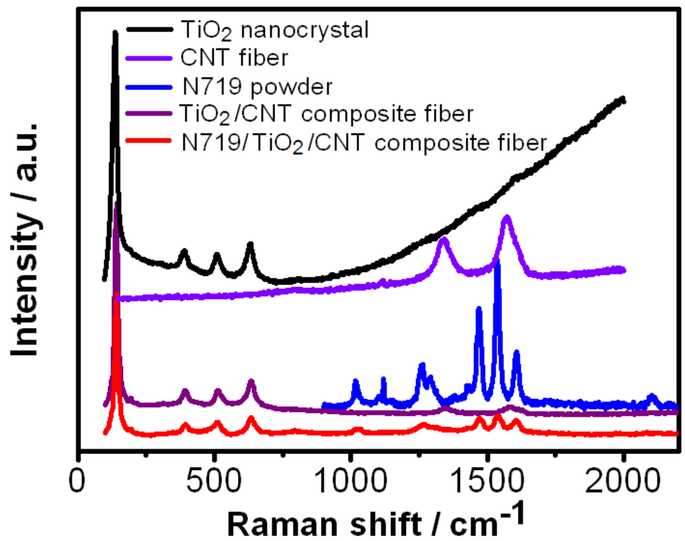

Figure S11. Raman spectroscopy of TiO2 nanocrystal (black line), pure CNT fiber (violet line), N719 (blue line), TiO_2/CNT composite fiber (purple line), and N719/ TiO_2/CNT composite fiber (red line), respectively.

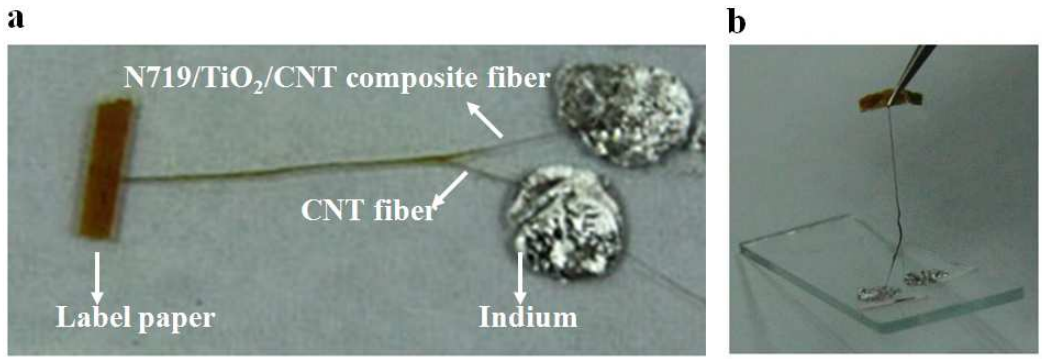

Figure S12. Photographs of a wire solar cell fabricated from two CNT fibers.

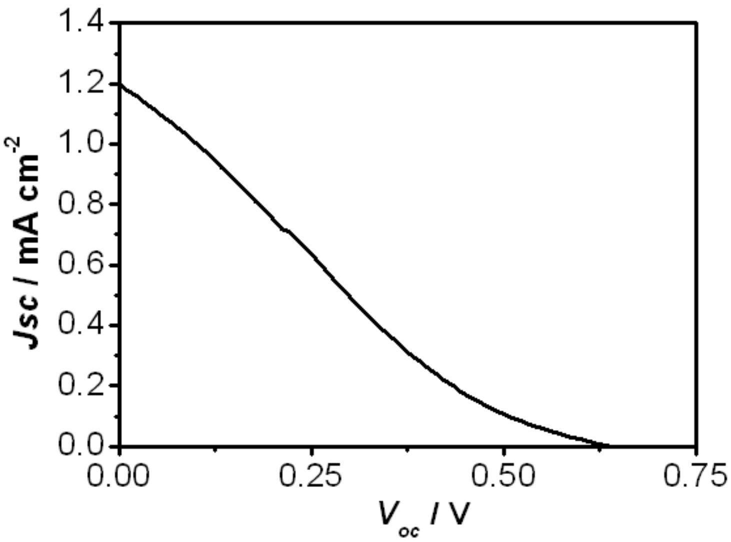

Figure S13. *J*-*V* curve of a fiber cell by using platinum wire fiber as counter electrode under AM1.5 simulated sunlight.

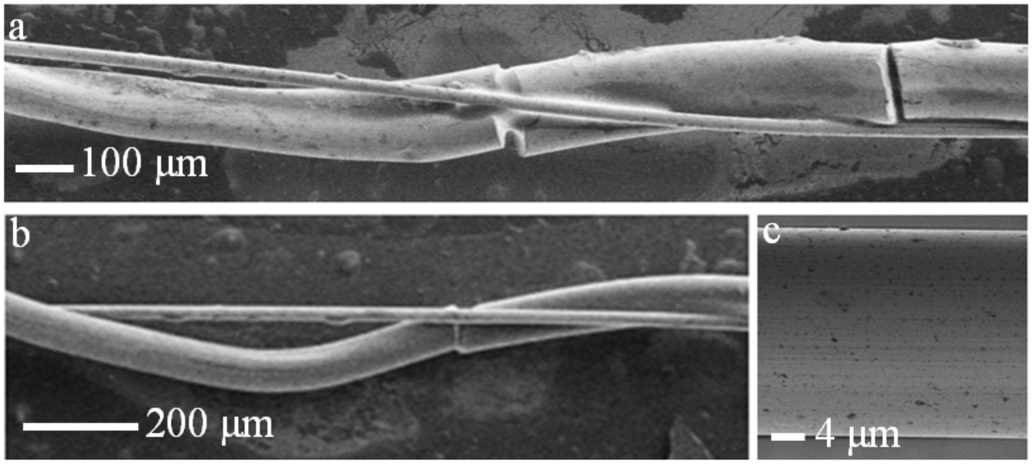

Figure S14. SEM images of a wire-shaped cell by using platinum wire as counter electrode. **a, b.** Two parts of the twined fiber structure. **c.** Side view of the platinum wire with smooth outer surface.

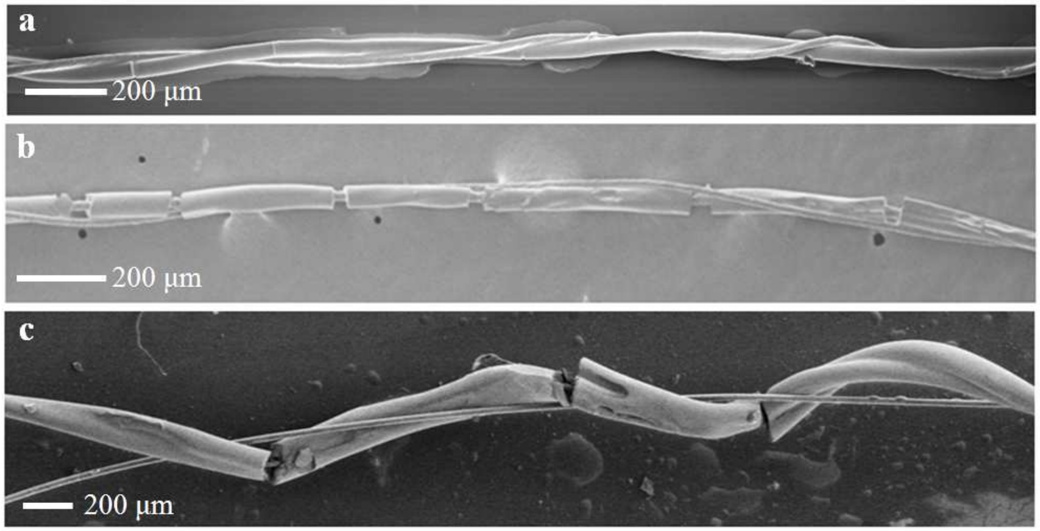

Figure S15. Assembled fiber solar cells using CNT fiber coated TiO2 layer with different thickness.

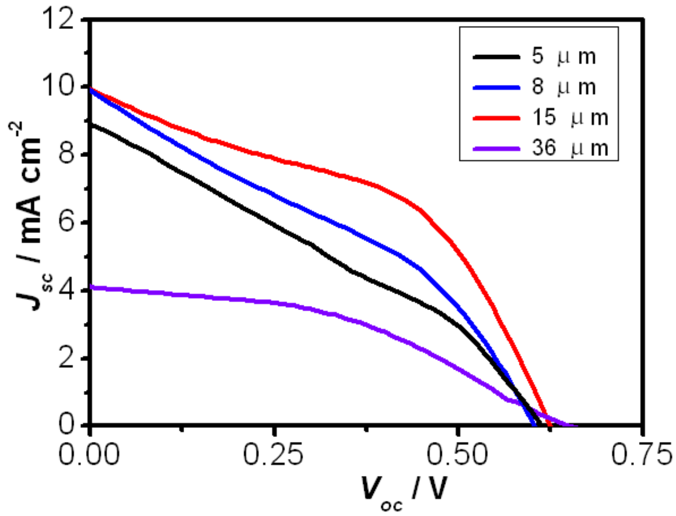

Figure S16. *J*-*V* curves of wire solar cells composed of TiO_2 nanocrystal layers with different thicknesses. The black, blue, and red lines correspond to the CNT fibers with TiO_2 thicknesses of 5, 8, 15 and 36 μm, respectively.

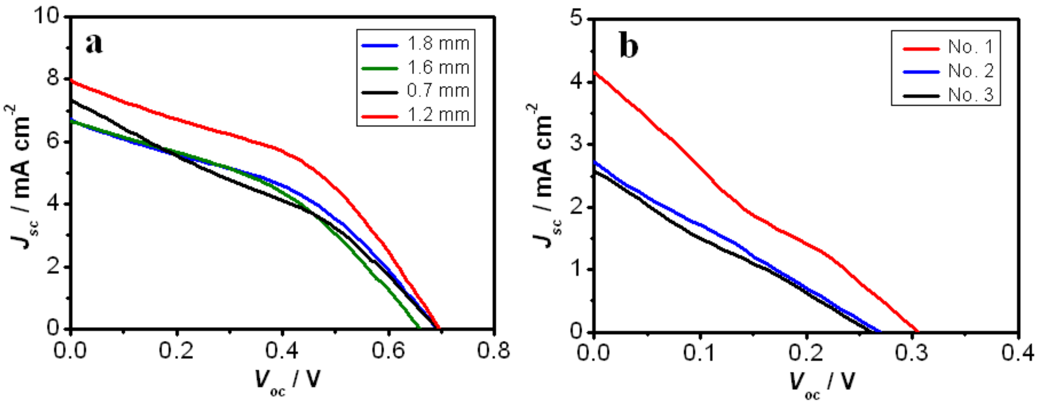

Figure S17. **a**. J-V curve of fiber-shaped solar cells with different twist pitch distances; **b**. J-V curve of fiber-shaped solar cells with two fiber electrodes parallel with each other.

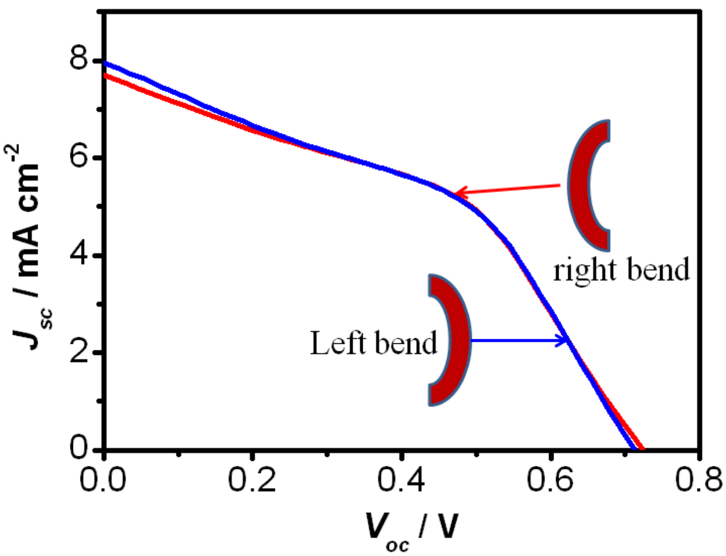

Figure S18. *J*-*V* curves of a fiber solar cell when it was bent to left and right side.

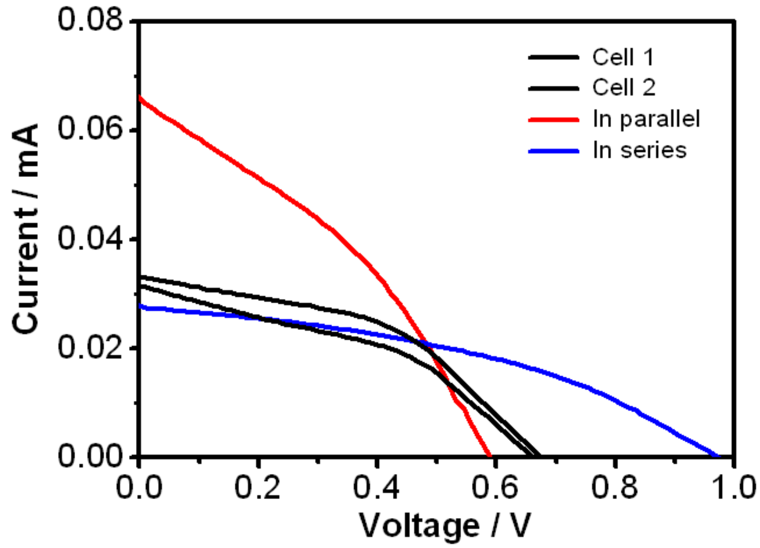

Figure S19. *I–V* curves of two wire solar cells, and their parallel and series connections.