

# Supplementary Materials: Comprehensive Study on Chemical and Hot Press-Treated Silver Nanowires for Efficient Polymer Solar Cell Application

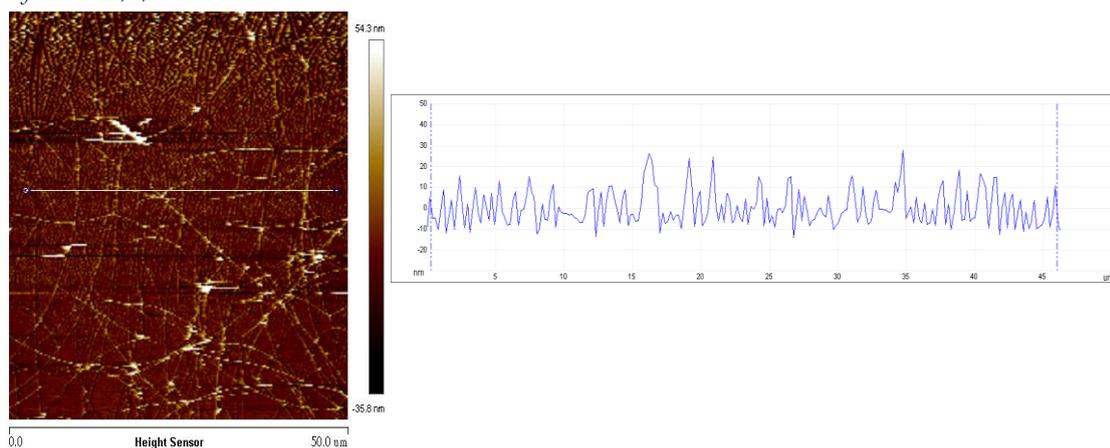
Yang-Yen Yu, Yo-Jen Ting, Chung-Lin Chung, Tzung-Wei Tsai and Chih-Ping Chen

## 1. Characterization and measurements

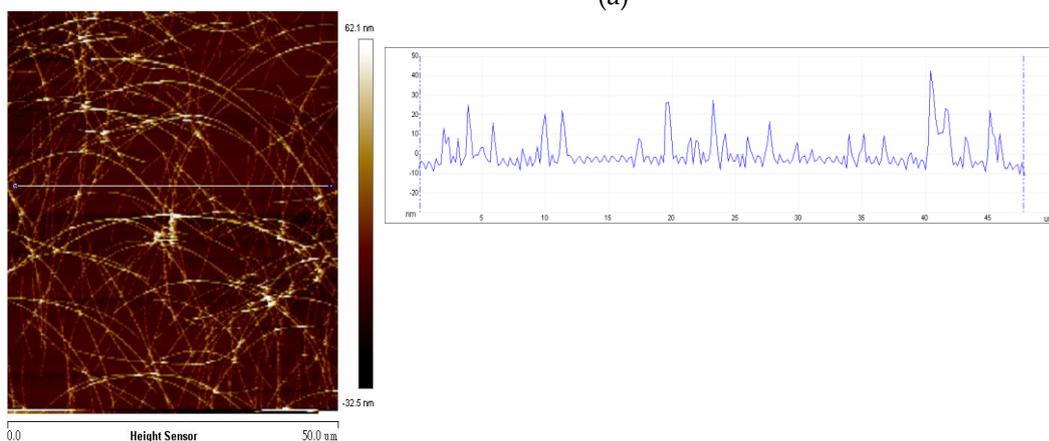
UV-Vis absorption spectra were recorded using a JASCO V-750 UV-Visible/NIR spectrophotometer. Energy levels were measured using a Riken Keiki AC2 photoelectron spectrometer (UV intensity: 50 nW). Surface morphologies of the polymer:PCBM thin films were observed through atomic force microscopy using a Nanoscope 3D Controller (MultiMode 3D SPM, Digital Instruments) operated in tapping mode at an ambient temperature; the etched Si probe exhibited a resonant frequency of 131 kHz and a spring constant of 11 N·m<sup>-1</sup>. Current–voltage (*J–V*) curves of PSC devices were measured using a computer-controlled Keithley 2400 source measurement unit (SMU) and a Newport solar simulator (Oriol Sol2A Class ABA Solar Simulators) under AM 1.5 G illumination. The illumination intensity was calibrated using a standard Si photodiode detector equipped with a KG-5 filter. The output photocurrent was adjusted to match the photocurrent of the Si reference cell to obtain a power density of 1000 W m<sup>-2</sup>. After encapsulation, all devices were operated under an ambient atmosphere at 25 °C. The active area of each device was 10 mm<sup>2</sup>.

## 2. Device fabrication

Glass/ITO substrates (Sanyo, Japan (8 Ω sq<sup>-1</sup>)) were patterned lithographically, cleaned and sonicated (with detergent, DI-water, acetone and isopropanol), dried on a hot plate (120 °C, 5 min) and treated with oxygen plasma for 5 min. PET substrate was used following the same cleaning and sonication process. For normal device fabrication, poly(3,4-ethylenedioxythiophene):polystyrene sulfonate (PEDOT:PSS, Baytron P-VP AI4083) was passed through a 0.45-μm filter before being deposited (thickness: ca. 30 nm) through spin-coating (3000 rpm) in air onto the ITO or AgNW substrates and dried at 110 °C for 30 min. The ZnO layer (40 nm) was prepared from a 0.5 M zinc acetate precursor solution (2-methoxyethanol). Active layer solutions of P3HT:PC<sub>61</sub>BM (1:0.9; 15 mg/mL), PTB7-Th:PC<sub>71</sub>BM (1:1.5; 10 mg/mL, with 3 vol% of 1,8-diiodooctane (DIO)) were stirred in *o*-dichlorobenzene (*o*-DCB) overnight, filtered through a polytetrafluoroethylene (PTFE; 0.2-μm) filter and then spin-coated onto the ZnO or PEDOT:PSS layers. A PffBT4T-2OD:PC<sub>71</sub>BM solution (donor–acceptor (D/A) ratio, 1:1.2) was formed in chlorobenzene (CB)/*o*-DCB (8:2, v/v) with 3% of DIO (PffBT4T-2OD concentration: 9 mg mL<sup>-1</sup>). To ensure complete dissolution of the polymer, the mixture was stirred at 110°C (hot plate) for a minimum of 3 h. Prior to spin-coating, the PffBT4T-2OD blend solution and the substrates/PEDOT:PSS or substrates/ZnO substrate were both preheated at approximately 100°C (hot plate). In a N<sub>2</sub>-filled glove box, the PffBT4T-2OD:PC<sub>71</sub>BM layers were spin-coated (800 rpm) from the warm PffBT4T-2OD blend solution onto the preheated substrates. The PffBT4T-2OD:PC<sub>70</sub>BM films were annealed at 90°C for 5 min and then transferred to a thermal evaporator's vacuum chamber. The active layer solution was filtered through a 0.2-μm polytetrafluoroethylene (PTFE) filter and then spin-coated on top of the ZnO and PEDOT:PSS layers. The device was completed by depositing a 30-nm-thick layer of Ca and a 100-nm-thick layer of Al or Ag at a pressure of less than 10<sup>-6</sup> torr.



(a)



(b)

Figure S1. AFM topography images of (a) AgNW and (b) HP-AgNW films.

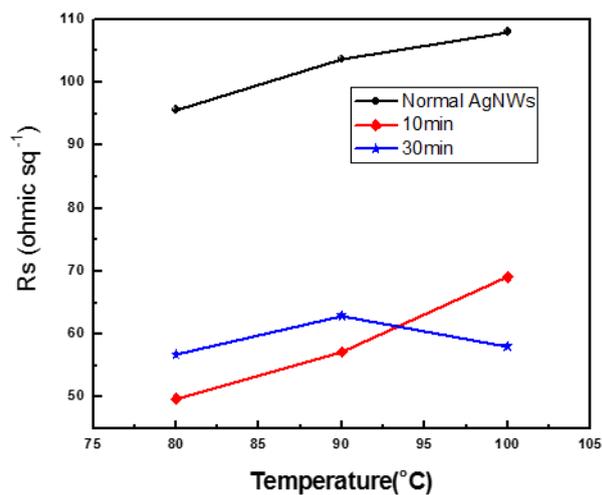
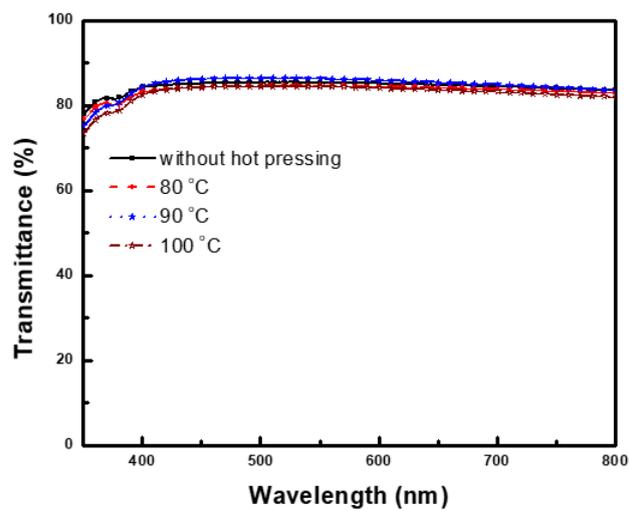
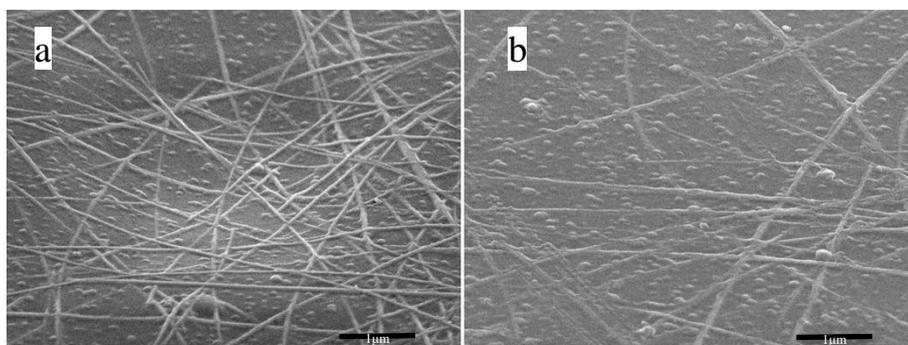


Figure S2.  $R_s$  of PET/AgNWs film at different hot pressing times and temperatures.



**Figure S3.** UV-Vis spectra of PET/AgNWs film treated at different HP temperatures for 10 min.



**Figure S4.** SEM images at a 45 degree inclination: (a) PET/AgNWs/PEDOT:PSS before hot-pressing treatment; (b) PET/AgNWs/PEDOT:PSS after hot-pressing treatment.