Suppoting Information

Supramolecular electrospun nanofibers with high conductivity at ultra-low carbon nanotube content

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Experimental Section

Materials

Poly(styrene) (PS) was purchased from Sigma-Aldrich (St. Louis, MO, USA). Gel permeation chromatography (GPC) analysis indicated that the molecular weight (M_w) of PS was ca. 280,000 g/mol, with a polydispersity index (PDI) of 2.87. Poly(vinylbenzyl uracil) (PVBU; M_w = 280,000 g/mol, PDI = 2.87) and diaminopyridine-functionalized polythiophene (PTDAP; M_w = 21,000 g/mol, PDI = 1.73) were synthesized according to our previously reported methods.[8c,d,h] Poly(styrene) (PS) was purchased from Sigma-Aldrich (St. Louis, MO, USA). Gel permeation chromatography (GPC) analysis indicated that the molecular weight of PS was ca. 280,000 g/mol, with a PDI of 2.87. Multi-walled carbon nanotubes (CNTs) were purchased from NanoLab Inc. (Waltham, MA, USA). All other chemicals and solvents were of the highest purity available and were purchased from Sigma-Aldrich. All solvents used for synthetic and chromatographic experiments were high-performance liquid chromatography (HPLC) grade and were acquired from TEDIA (Fairfield, OH, USA) or Fisher Scientific (Fair Lawn, NJ, USA). *N*,*N*-dimethylacetamide (DMAc) was distilled over calcium hydride prior to use.

Preparation of CNT-incorporated electrospun polymer nanofibers

The 10/90 PTDAP/PVBU (or 10/90 PTDAP/PS) blend composites with different contents (0.3~2.0 *wt%*) of CNTs were dispersed in DMAc solvent by ultrasonication for 1 h. The sample solutions were pumped through a metal needle with an inner diameter of 0.34 mm at a feed rate of 0.2 ml/h using a syringe pump (model 100; KD Scientific Inc., Boston, MA, USA). The distance between the tip of the syringe and the collector was fixed at 15 cm. A constant voltage of 20 kV was used to produce electrospun fibers and the fibers were collected on aluminum foil in grounded collection plates.

Measurements

Ultraviolet-visible (UV–Vis) and photoluminescence (PL) spectra. UV–Vis and PL spectra were

determined on a Hewlett Packard 8452A diode array spectrophotometer (Hewlett-Packard, Palo Alto, CA, USA) and a Hitachi F-4500 luminescence spectrometer (Hitachi Co., Ltd., Tokyo, Japan), respectively. The PL spectra were measured at 25 °C under an excitation wavelength of 430 nm.

Scanning Electron Microscopy (SEM). Samples were firmly attached onto the silicon substrate, sputtered with platinum and characterized using field-emission SEM (Hitachi S-4700, Tokyo, Japan) at high accelerating voltages of over 10 kV.

Transmission Electron Microscopy (TEM). Ultrathin-section TEM images of electrospun nanofibers were obtained using a FEI T12 TEM FEI Co. Eindhoven, Netherlands) operating at 120 kV.

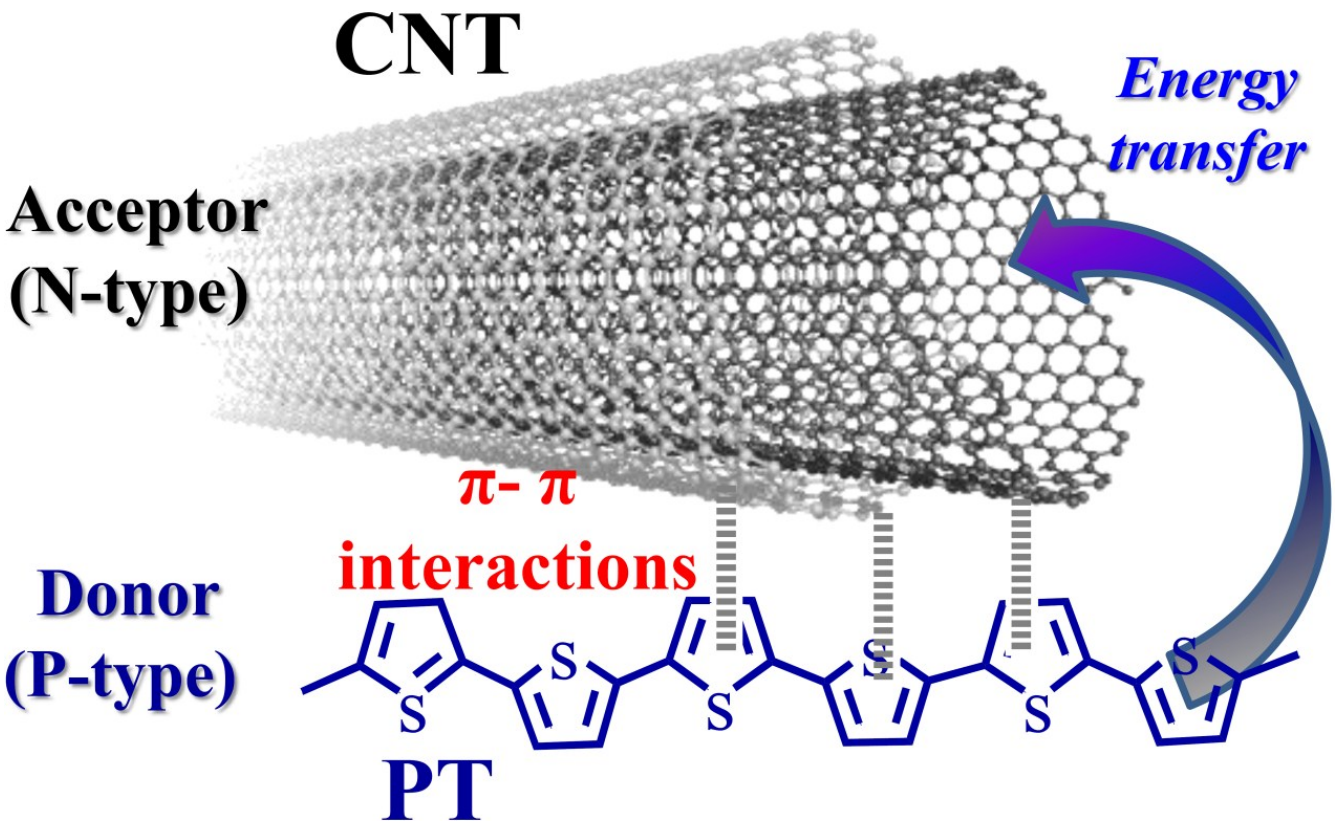
Differential Scanning Calorimetry (DSC). A TA Q-20 thermal analyzer (New Castle, DE, USA) was used to perform DSC experiments. Test samples (ca. 5 mg) sealed in aluminum pans were analyzed over the temperature range of 30-250 °C at a heating/cooling rate of 10 °C/min.

Raman spectra. Samples were placed directly onto the surface of silicon substrate. All spectra were collected using a Witec Confocal Raman (Model CRM 2000, Ulm, Germany). Spectral data were recorded between 500 and 2000 cm^{-1} at a resolution of 2.0 cm^{-1} at 25 °C. The excitation source was a helium-neon (He-Ne) laser with a power density of ca. 30 W/cm^2.

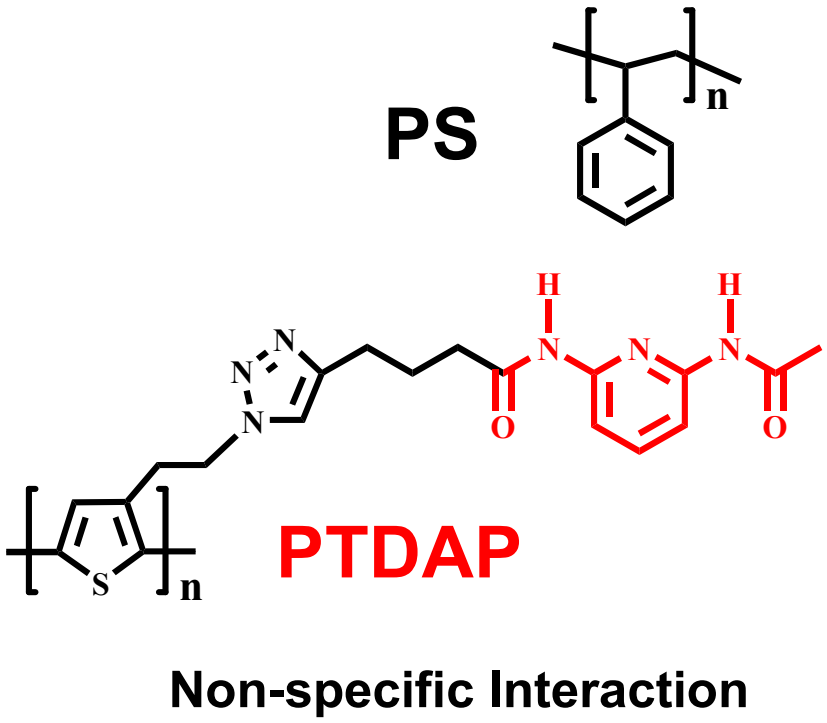
Conductivity Measurements. Electrical conductivity properties of electrospun fibers were measured using a Pico Ammeter (Keithley model 617, Cleveland, OH, USA). For conductivity measurements, each of the samples was placed in a conductivity cell between two gold electrodes at 25 °C and 30% relative humidity. Conductivity was calculated according to the equation:

$$\sigma = \frac{d}{AR}$$

where σ is conductivity, d is sample thickness, A is the s surface area of the gold electrode, and R is bulk resistance of the sample measured using an ammeter.



Scheme S1. Structural representation of the energy transfer from polythiophene (PT) to CNTs, indicating the nature of the π–π interactions between the materials.



Scheme S2. Structural representations of PS and PTDAP.

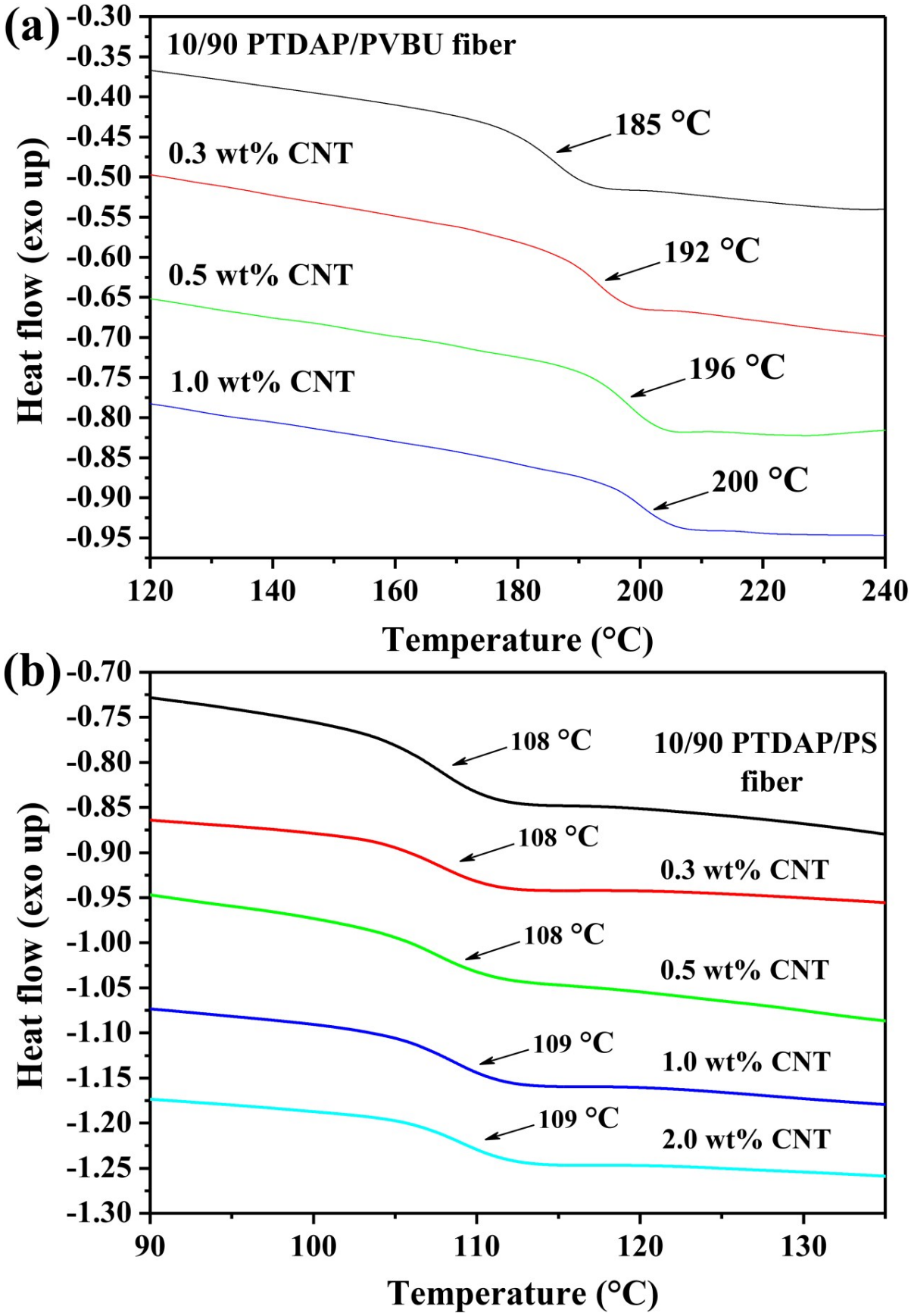


Fig. S1: DSC thermograms of the second heating scans for **(a)** CNT/PTDAP/PVBU and **(b)** CNT/PTDAP/PS fibers.

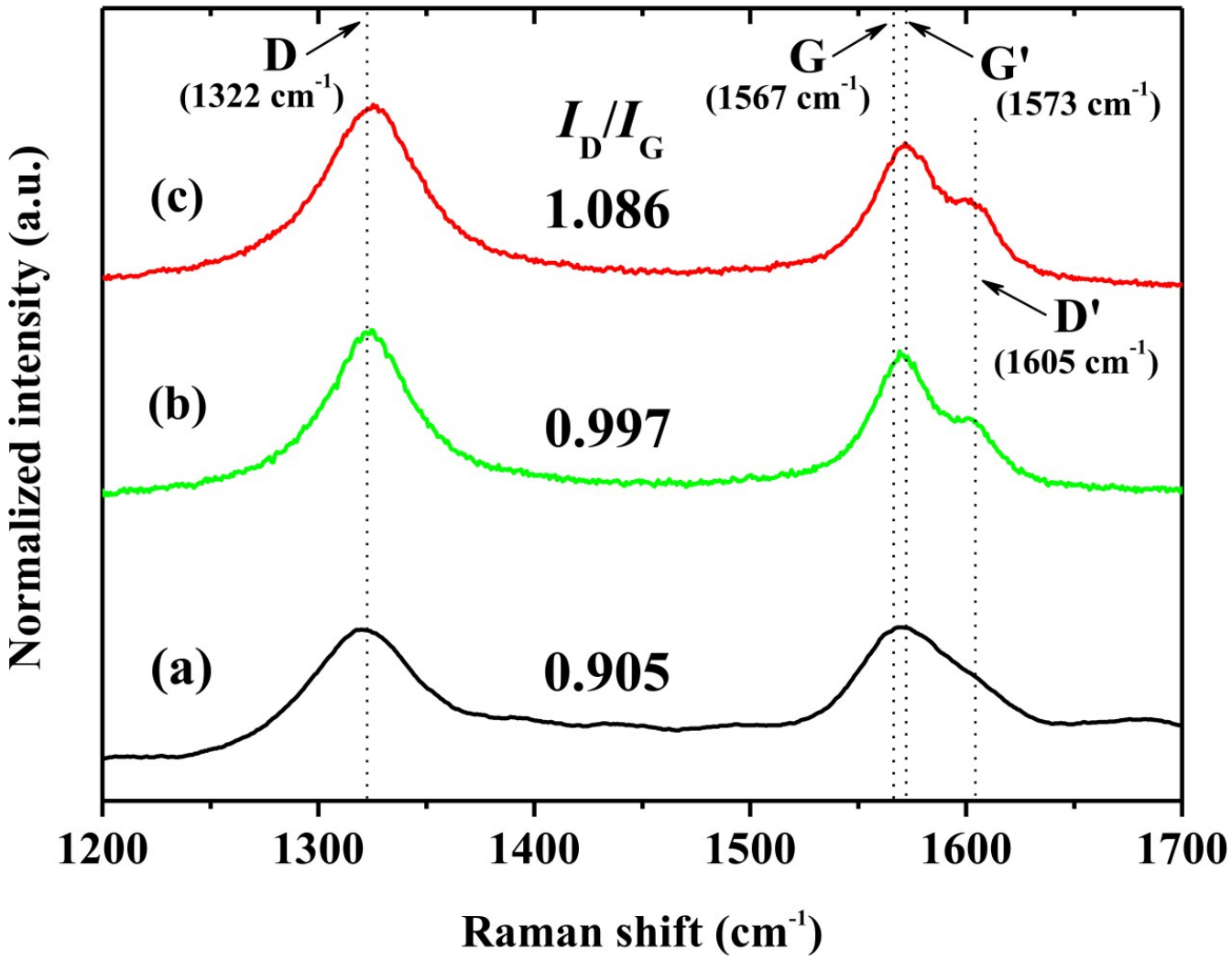


Fig. S2: Raman spectra for **(a)** CNT, **(b)** CNT/PTDAP/PS and **(C)** CNT/PTDAP/ PVBU fibers.