Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Multifunctional fabrics of carbon nanotube fibers

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Video S1: CNT cylinder condensing in water and the resultant fiber pulling out of water and winding on a spool

Video S2: Twisting a bundle of CNT fibers into a yarn

Video S3: Automatically knitting a CNT yarn into a fabric

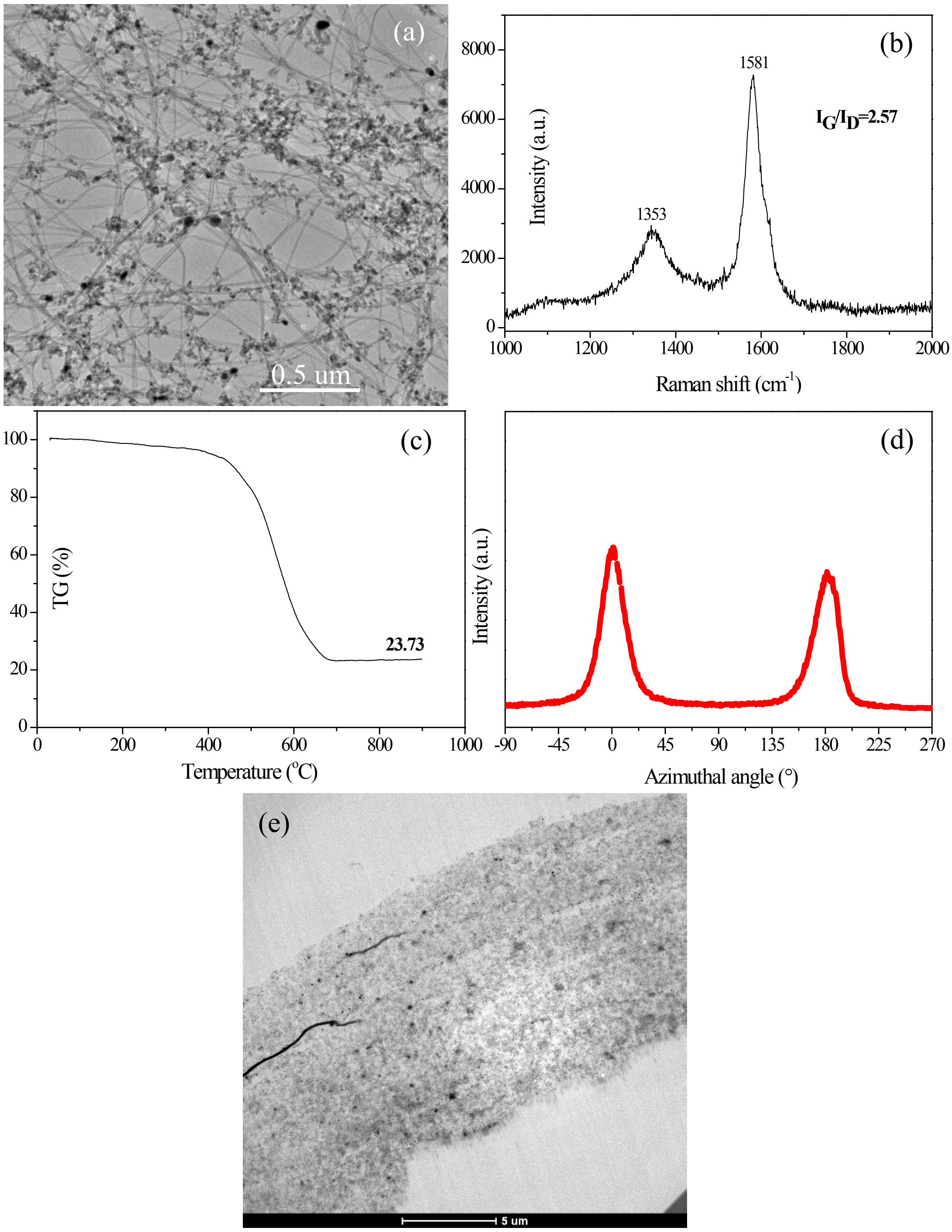

Figure S1. Characterization of CNT fibers: (a) TEM image, (b) Raman spectrum, (c) TGA curve, (d) azimuthal scanning profile, and (e) cross section.

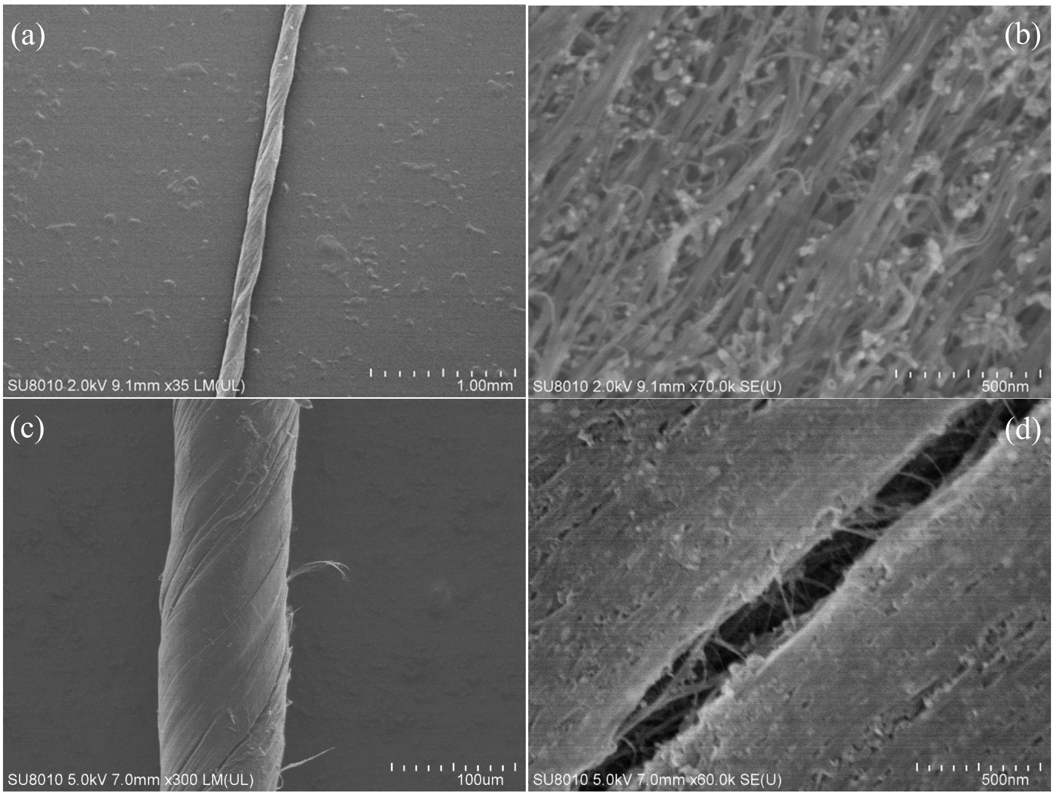

Figure S2. SEM images of CNT yarns: (a,b) 5/1000Y and (c,d) 5/3000Y.

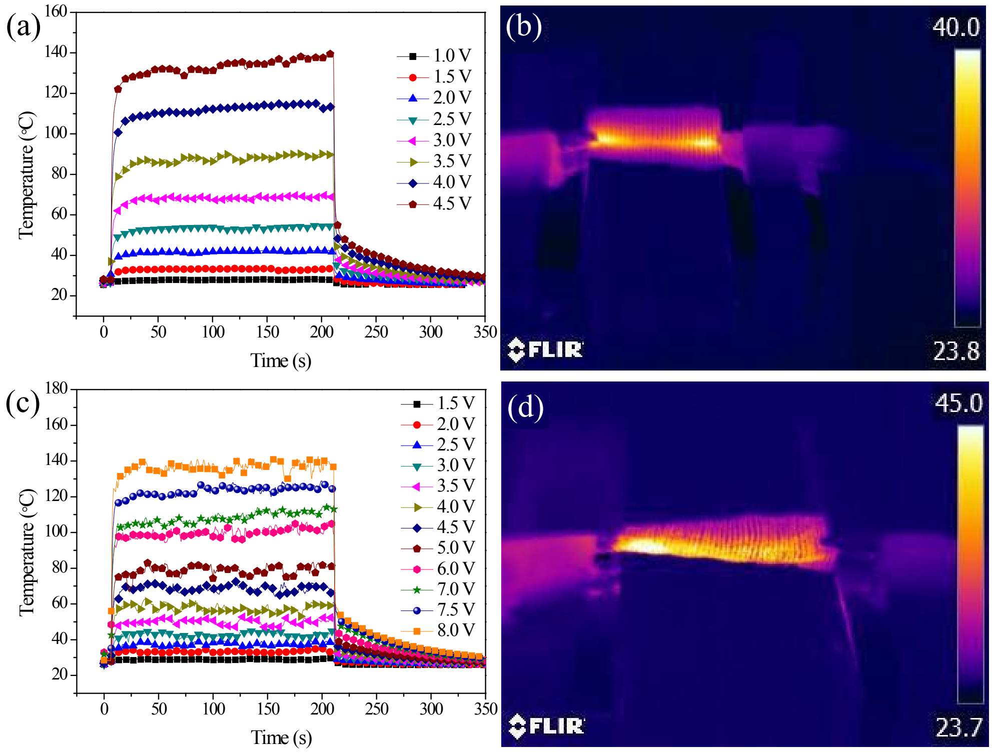

Figure S3. Electrothermal performance of CNTFFs. Temperature-time curves of CNTFF-10/2000Y (a) and CNTFF-5/2000Y (c) at different voltages, and Infrared images of CNTFF-10/2000Y (b) and CNTFF-5/2000Y (d) at 2 V and 3 V, respectively.

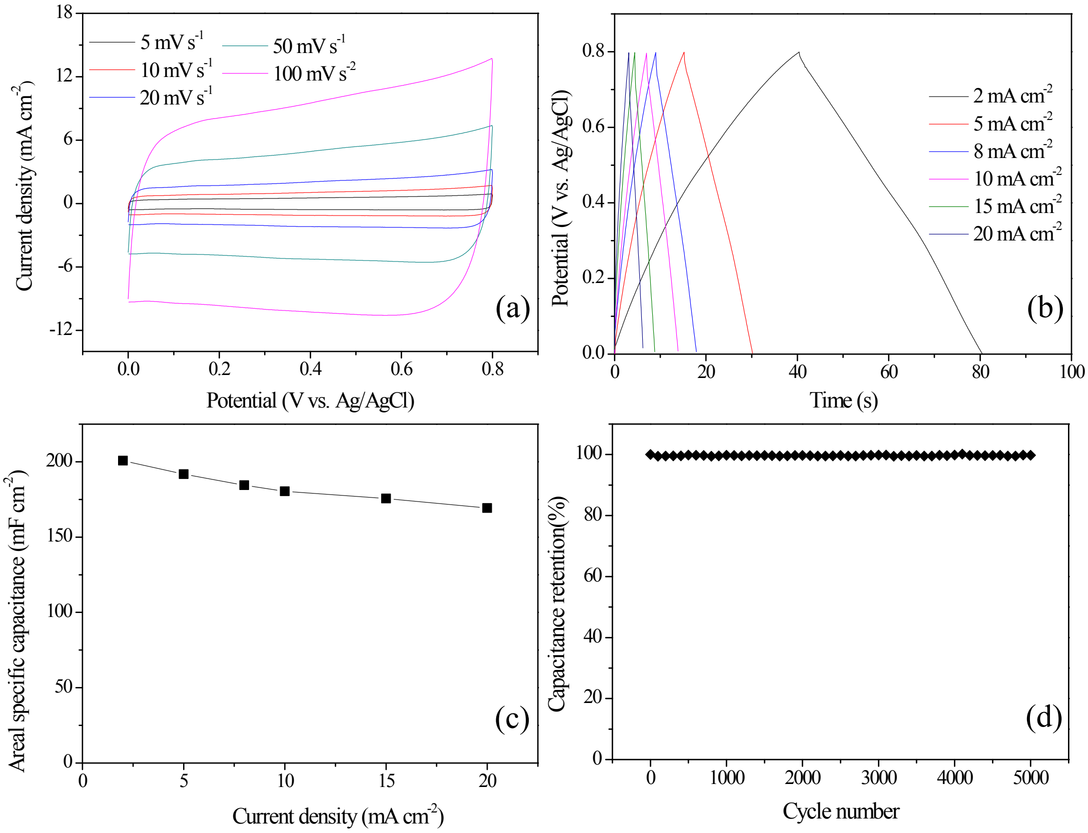

Figure S4. Electrochemical performance of CNTFF electrodes. (a) CV curves at scan rates from 5 to 100 mV s^{-1}, (b) GCD curves at current densities from 2 to 20 mA cm^{-2}, (c) Areal specific capacitance versus different current densities calculated from GCD test, and (d) Cycle stability at the current density of 20 mA cm^{-2}.

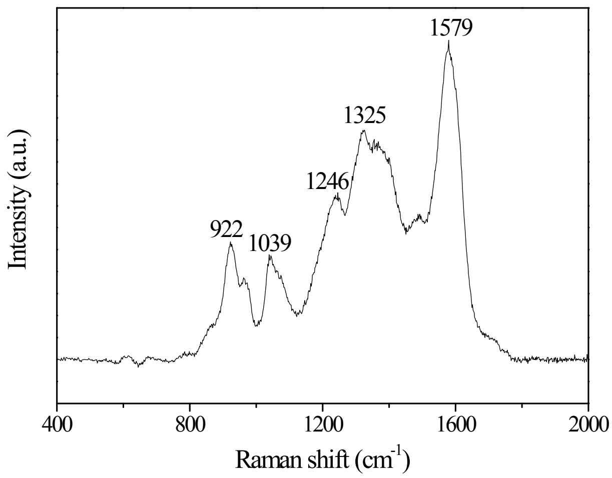

Figure S5. Raman spectrum of PPy/CNTFF. The peaks at 922, 1039, 1246, 1325 and 1579 cm^{-1} corresponding to the PPy characteristic peaks of ring deformation, C-H in-plane deformation, C-H in-plane bending, ring stretching and C=C stretching, respectively.

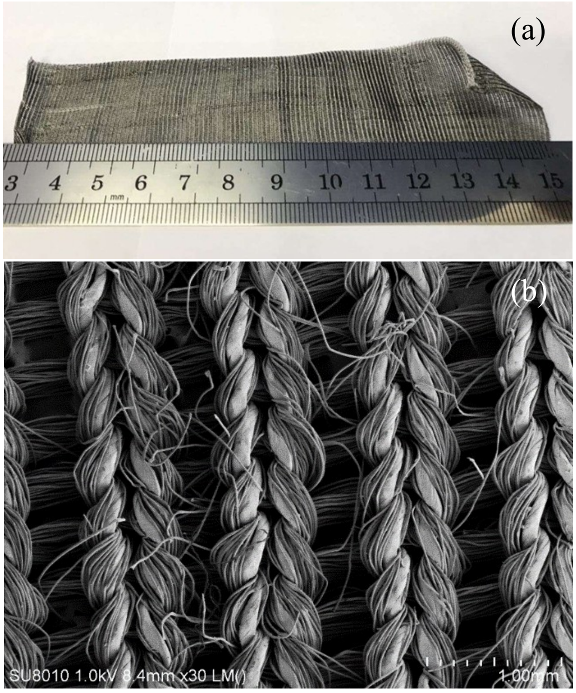

Figure S6. CNT/PET hybrid knitted fabrics: (a) Photograph and (b) SEM image.

Table S1. Mechanical, electrical and thermal properties of CNTFFs.

Sample	Width (cm)	Thickness (cm)	Cross-sectional area (cm^2)	Density (g/cm^3)	Stress (MPa)	Strain (%)	Electrical conductivity (S/m)	Thermal conductivity (W/mK)
CNTFF-5/2000Y	1	0.020	0.020	0.18	4.84	21	25	0.04
CNTFF-10/2000Y	1	0.038	0.038	0.26	3.90	47	55	0.06
CNTFF-6-5/2000Y	1	0.067	0.067	0.36	6.85	46	110	0.13

Table S2. Comparison of the Joule heating performance of the CNTFFs with previously reported film heaters and commercial heating elements.

Material	Driving voltage (V)	Saturated temperature (°C)	Response time (s)	Ref.
CNTFFs	3	131	10	This work
Graphene fiber fabric	10	382	0.7	1
Carbon fiber paper	10	147	8	1
Graphite paper	10	99	42	1
Graphene paper	3.2	42	10	2
Graphene/glass	24	80	~300	3
$AuCl_3$-doped graphene/glass	10	80	~300	3
Graphene-$AuCl_3$/PET	12	100	~100	4
Graphene-HNO_3/PET	12	65	~100	4
RGO film/PI	29	177	120	5
RGO/quartz	60	206	~120	6
RGO/PI	60	72	~10	6
RGO/PET fabric	6	50	3	7
SWCNT/PET	12	80	50	8
CNT/cotton cloth	12	38	~300	9
Ag NW/PDMS	5	80	~50	10
Ag mesh/glass	9	128	~300	11
Ag NW/cotton cloth	0.9	38	~300	9
PEDOT/cotton textile	7	83.9	~70	12
PPy/cotton textile	9	83	100	13
PTC heating plate	12	60-220	NA	Commercial
MCH heating plate	10	130-340	>10	Commercial

The response time is denoted as the time required to reach the saturated temperature;

PET: polyethylene-terephthalate; RGO: reduced graphene oxide; PI-polyimide; PDMS: polydimethylsiloxane; NW: nanowire; PEDOT: poly(3,4-ethylenedioxythiophene); PPy: polypyrrole; PTC: positive temperature coefficient; MCH: metal ceramic heater;

Table S3. Comparison of the areal capacitance of the PPy/CNTFF electrode with previously reported fabric electrodes.

Electrode materials	Mass loading ($mg\ cm^{-2}$)	Test condition	Areal capacitance ($mF\ cm^{-2}$)	Ref.
PPy/CNTFF	6.88	5 mA cm^{-2}	4734	This work
SiC/carbon fabric	NA	50 mV s^{-1}	23	14
PANI/carbon cloth	NA	2 mA cm^{-2}	787.4	15
MnO_2/carbon cloth	NA	0.13 mA cm^{-2}	230	16
$Ni(OH)_2$/carbon cloth	NA	2 A g^{-1}	1136	17
Fe_2O_3/carbon cloth	4.3	0.5 mA cm^{-2}	382.7	18
MoO_{3-x}/carbon fabric	3.0	2 mA cm^{-2}	500	19
Co_9S_8/carbon cloth	NA	5 mV s^{-1}	2350	20
Co_3O_4@RuO_2/carbon cloth	2.0	1 mV s^{-1}	1180	
RGO/carbon cloth	1.4	1 mA cm^{-2}	264	21
MnO_2/carbon cloth	2.0	1 mA cm^{-2}	331	
RGO/stainless steel fabric	4.4-5.6	2 mA cm^{-2}	730.8±8.7	22
MWCNT/RGO/Ni-coated cotton fabric	23.7	20 mA cm^{-2}	6200	23
PPy/RGO/PET textile	3.39	1 mA cm^{-2}	1117	24
PPy/cotton fabric	12.3	5 mA cm^{-2}	3553	25
WO_3/graphene/PET textile	NA	1 mV s^{-1}	308.2	26
PANI/CNT/PET fabric	NA	1 mA cm^{-2}	386	27

PANI: polyaniline; RGO: reduced graphene oxide; PPy: polypyrrole; PET: polyethylene-terephthalate;

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