Supporting Information

N-type silver ammonia-polyethyleneimine/single-walled carbon nanotube composite films with enhanced thermoelectric properties

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Materials

Polyethyleneimine (PEI, molecular weight: 10,000, purity>99%) was purchased from Aladdin Industrial Corporation (Shanghai, China). Single-walled carbon nanotubes (SWCNTs, diameters: 1-3 nm, purity ≥85 %, mixed large diameter) were purchased from Shenzhen Nanotech Port Co., Ltd. (Shenzhen, China). Silver nitrate, sodium borohydride, ethanol, and ammonia were purchased from Sinopharm Chemical Reagent Co., Ltd. (Beijing, China). All chemicals were analytical grade and used directly without further purification.

Characterization

The surface morphologies were characterized using a field emission scanning electron microscope (FESEM, ZEISS GeminiSEM 300, Germany). The microstructures were characterized using a transmission electron microscope (TEM, JEOL JEM-2010, Japan). The main chemical groups were characterized by Raman spectra with 532 nm excitation wavelength (Raman, DXR, USA). Element compositions were characterized by X-ray photoelectron spectroscopy (XPS, ESCALAB Xi+, USA). Thermoelectric parameters including the electrical conductivity (σ) and Seebeck coefficient (S) were characterized by TE test system (MRS variable temperature series, China), and power factor (PF) was calculated by the formula $PF = \sigma S^2$. The dimensions of the samples were about 10.0 mm × 5.0 mm × 10 μm, and the temperature gradient at the collection point is set to 0.3 to 3.5 °C along the longitudinal direction of the sample. The carrier concentration and mobility were measured on a Hall effect measurement system under a constant magnetic field (0.2 T) (Pasic-Hall HT50, Precision Systems Industrial Ltd., China). The output voltage and output power generated by the TE device were measured by a self-made system in the environment and are calculated by the temperature difference (ΔT, provided by the Peltier device and determined by the T-type thermocouple) and the change of the thermoelectric voltage (ΔV, measured with a Keithley 2000 multimeter). Then, the output power (P) of TE device was calculated by the formula $P = V^2/R$, where V and R is output voltage and external resistance, respectively.

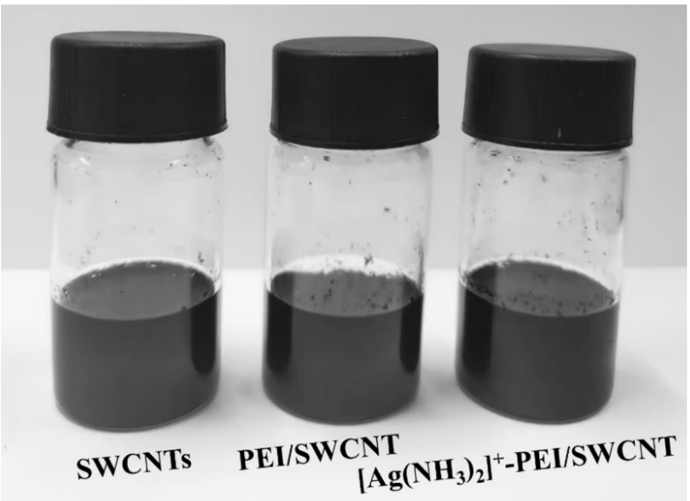

Fig. S1 dispersions of SWCNTs, PEI/SWCNT, and $[Ag(NH_3)_2]^+$-PEI/SWCNT.

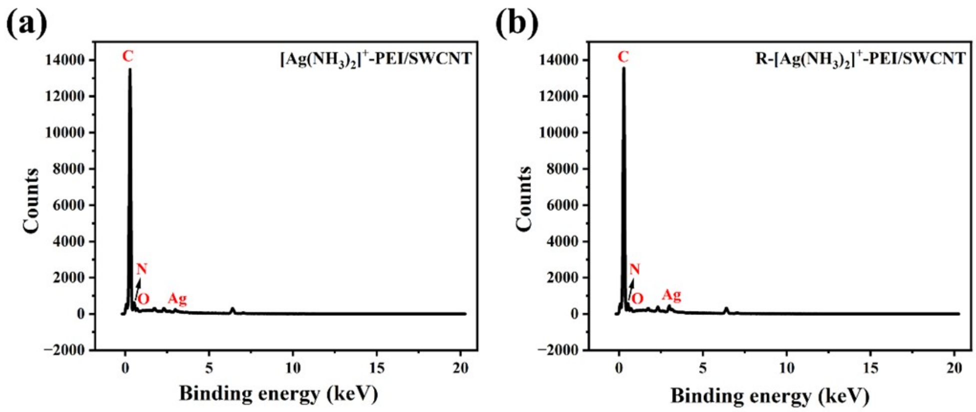

Fig. S2 EDS spectra of (a) $[Ag(NH_3)_2]^+$-PEI/SWCNT, (b) R-$[Ag(NH_3)_2]^+$-PEI/SWCNT.

Table S1 Density of the samples

Sample	Carrier Type	Density (g cm^{-3})
SWCNTs	p	0.73
50%PEI/SWCNT	n	0.69
$[Ag(NH_3)_2]^+$- PEI/SWCNT-1	n	0.73
$[Ag(NH_3)_2]^+$-PEI/SWCNT-2	n	0.81
$[Ag(NH_3)_2]^+$-PEI/SWCNT-3	n	0.73
$[Ag(NH_3)_2]^+$-PEI/SWCNT-4	n	0.81
$[Ag(NH_3)_2]^+$-PEI/SWCNT-5	n	0.68
R-$[Ag(NH_3)_2]^+$- PEI/SWCNT-1	n	0.70
R-$[Ag(NH_3)_2]^+$- PEI/SWCNT-2	n	0.74
R-$[Ag(NH_3)_2]^+$- PEI/SWCNT-3	n	0.73
R-$[Ag(NH_3)_2]^+$- PEI/SWCNT-4	n	0.82
R-$[Ag(NH_3)_2]^+$- PEI/SWCNT-5	n	0.70

Table S2 Content of elements for the sample in XPS spectra

Sample/Atomic (%)	C	O	N	Ag
$[Ag(NH_3)_2]^+$- PEI/SWCNT-2	87.43	3.63	8.26	0.68
R-$[Ag(NH_3)_2]^+$-PEI/SWCNT-4	82.43	12.29	5.17	0.13