Electronic supplementary information to:

Inkjet deposition and characterisation of transparent conducting electroactive polyaniline composite films with high carbon nanotube loading fraction.

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1. Materials

Catalytic chemical vapour deposition produced multi-walled carbon nanotubes (MWNT) were obtained from Nanocyl S.A. (Belgium, batch no NFL60). Aniline (Aldrich) was distilled and stored at -4 °C prior to use. The highly water-soluble polyaniline, poly(2-methoxyaniline-5-sulfonic acid) (PMAS) was polymerised and purified using in-house procedures as described in reference 1.

2. Effect of sonication on PMAS molecular weight.

Solution of PMAS at concentration ~ 1 mg / ml were sonicated with a Branson Digital Ultrasonic Sonifier 450D (400W, 3 mm tapered microtip) for 2, 5, 10, 30 and 60 minutes at 16 W in pulsed mode (2 s on, 1 s off). Gel permeation chromatography (GPC) indicated that the PMAS molecular weight decreased with increasing sonication time, see Table 1.

Table S1. Effect of sonication time (in pulsed mode) on PMAS molecular weight.

Sonication time (minutes)	Molecular weight (Da)
0	8650
2	8320
5	8110
10	7970
30	7590
60	7115

3. Loading fraction

The MWNT loading fraction is calculated as follows. Our previous work[2] determined that 70% of aniline starting amount (37 mg) is consumed during polymerization. Carbon nanotubes are stabilized in 80 mg PMAS for MWNT:aniline weight ratios 0.1, 0.2, 0.4, 0.6, 1.35 and 2.7. Hence a MWNT:aniline weight ratio of 0.1 corresponds to a MWNT loading fraction of 3.4 %, e.g. 3.75 mg MWNT in ~110 mg polymeric material.

4. UV-visible spectra

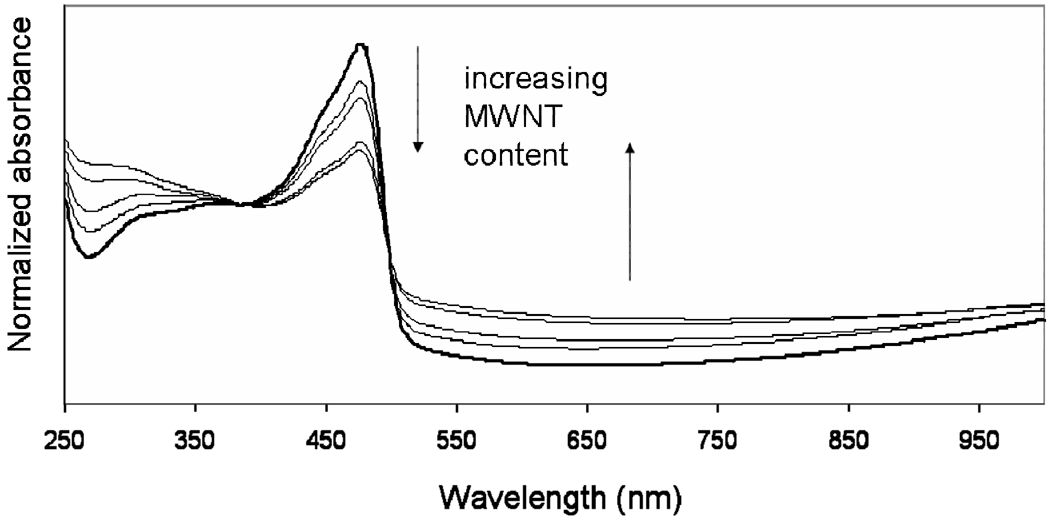

Figure S1. UV-visible absorption spectra (normalized) of PAn/PMAS-MWNT dispersions. Arrows indicate the effect of increasing MWNT loading, e.g. decrease in 450 nm band, increase in absorbance above 500 nm.

5. Free standing film measurements

Film thickness of free standing films prepared by drop casting was determined by Mitutoyo digital micrometer. Conductivity measurements (Table 2) were carried out using a JANDEL four-point probe resistivity system (model RM2).

Table S2. Sheet resistance and electrical conductivity of free standing films as a function of MWNT loading fraction.

MWNT loading fraction	Sheet resistance (Ω/□)	Conductivity (S/cm)
0	230.4 ± 13.4	3.1 ± 0.2
3.4	60.4 ± 1.1	7.2 ± 0.1
6.6	38.8 ± 0.9	10.3 ± 0.2
12.4	16.9 ± 0.7	16 ± 0.6
17.5	14.3 ± 0.4	24.9 ± 0.7
32.0	5.0 ± 0.1	51.3 ± 1.3

6. Thermo gravimetric analysis (TGA).

TGA measurements were carried out using a TA Instruments TGA Q500 thermogravimetric analyzer burning 1 mg of free standing films in air, using a flow rate of 60 mL/min and a ramp of 10 C/min up to 800 °C. The spectrum for MWNTs was obtained on powder material as supplied by the manufacturer.

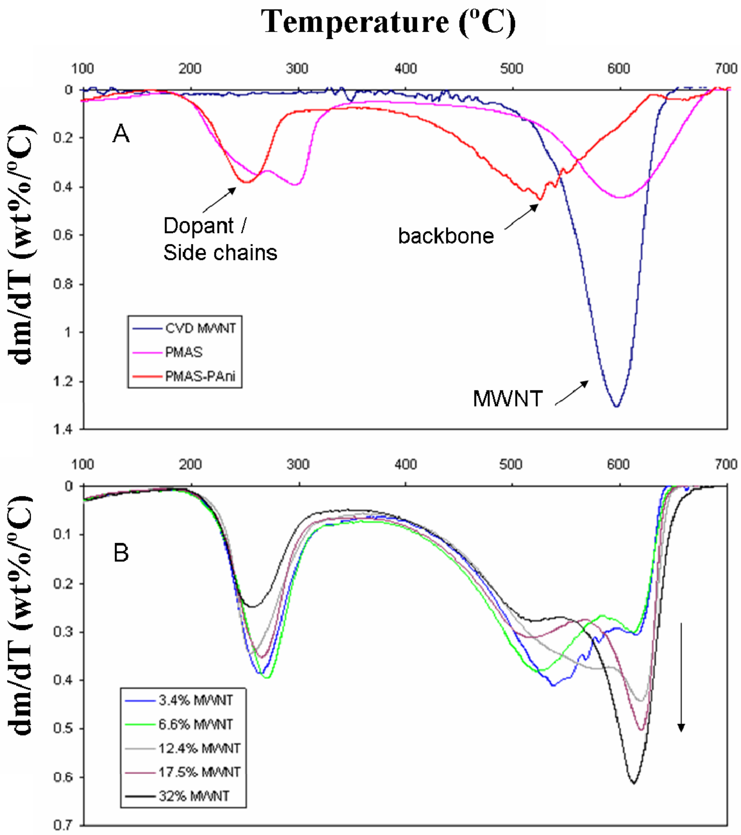

Figure S2. Thermogravimetric analysis (derivative) of starting materials (A) and carbon nanotube composite materials (B). Number in figure B indicate MWNT loading fraction.

6. Cyclic voltammotry (CV).

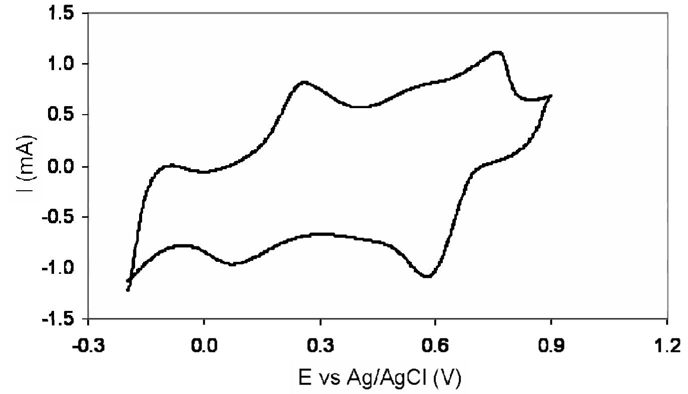

Figure S3. Cyclic voltammogram of composite film (MWNT loading fraction 3.4 %) printed onto Pt-ITO in 1 M HCl, scan rate 500 mV/s.

References

[1] Masdaloromoor, F; Innis, P.C.; Ashraf, S.; Wallace, G.G. *Synth. Met.* **2005**, *153*, 181.

[2] Masdarolomoor, F.; Innis, P.C.; Ashraf, S.; Kaner, R.B.; Wallace, G.G. *Macromol. Rapid. Commun.* **2006**, *27*, 1995.