Electronic supplementary material to:

Inkjet printed water sensitive transparent films from natural gum - carbon nanotube composites.

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1) Sonication conditions.

The preparation of nanotube dispersions is as follows. Two and a half (2.5) milligram of single-walled (SWNT) or multi-walled carbon nanotubes (MWNT) are added to 2 mL of aqueous solutions of the dispersant (gums or surfactant) in a 3 mL vial. The solutions are subjected to ultrasonic treatment at 16 W for 90 s in pulsed mode (0.5 s on, 0.5 s off) with a sonicator (Branson Digital Ultrasonic Sonifier 450D, 400W, 3 mm tapered microtip). The vial is submerged in an ice bath to prevent heating of the solution during sonication. Subsequently the dispersion was filtered through glass wool under vacuum.

The average molecular weights of gellan gum has been reported as 200-300 kDa,[1] while the that of xanthan gum has been reported to be in excess of 1000 kDa.[2] At present it is unclear what the effect of sonolysis is on the degradation of our biopolymers, as no data has been reported in the literature. However similar studies on chitosan, a related polysaccharide, indicate that the molecular weight of chitosan decreased with the sonolysis time, with

percentage decrease in molecular weight up to 85 % per hour[3]. Therefore it is reasonable to assume that our sonication time of 90 s does not significantly degrade our biopolymers.

2) Photographs of destabilised dispersion. The photographs clearly show that decreasing the pH through addition of HCl results in destabilisation of the solution compared to reference sample. Transmission electron microscopy images (discussed in the main text) were prepared using the supernatant of the dispersions.

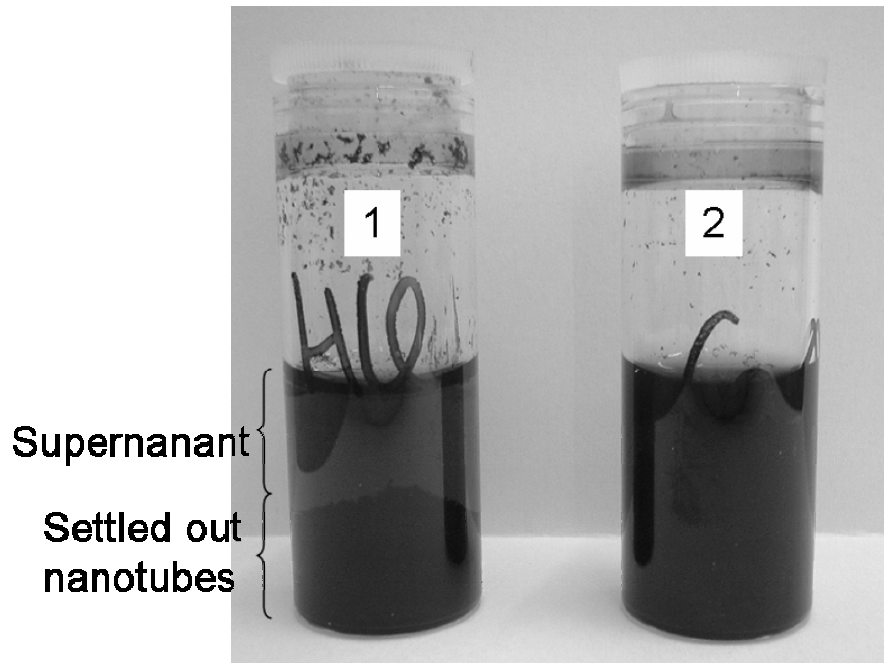

Figure ESI-1. Photographs of destabilised and reference dispersions: 1) Dispersion after decreasing pH through addition of with 10^{-3} M HCl, and 2) Reference dispersion after addition of Milli-Q water.

3) Optical transparency of films prepared via drop casting. MWNT were dispersed in aqueous solution of gellan gum (0.1 % w/v) using the procedure as described above without the filtering step. Films were drop cast onto glass microscope slides from gellan gum solution (0.1 % w/v) and MWNT-gellan gum dispersion. Transmittance was determined using a Perkin-Elmer Unicam UV3 UV-vis spectrometer.

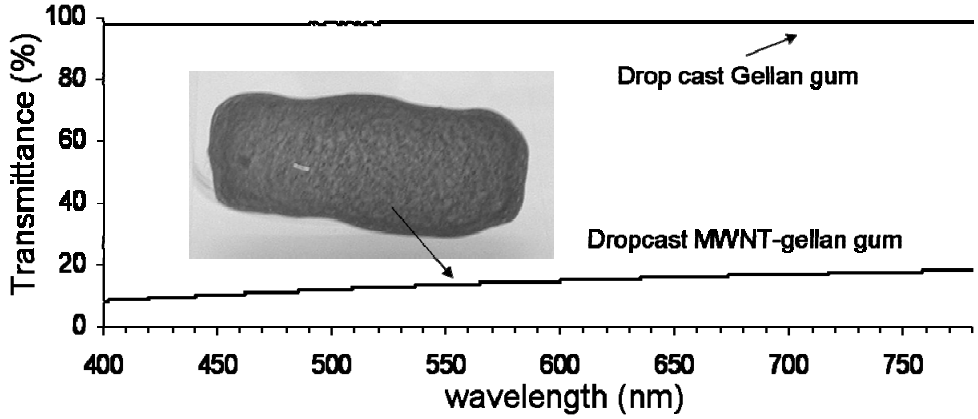

Figure ESI-2. Transparency of gellan gum and MWNT-gellan gum films prepared by drop casting from solution.

4. Electrical and Sensing measurements:

Films were connected to copper electrodes (channel length ~2 cm) in a sealed measurement chamber (650 mL). Current-voltage characteristics (*I-V*) were investigated under N_2 flow of 7 mL/s, ambient conditions, and under saturated water conditions.

Sensing measurements were carried out as follows. Water, ethanol, dimethyl sulfoxide (DMSO), toluene and hexane vapours were generated by vaporisation in a glass vial. Nitrogen gas at flow rate 7 mL/s was used as the carrier gas to flow the vapour from the glass vaporisation vial to the measurement chamber. The electrical current at constant voltage (4 V) across films was monitored with the digital multimeter.

References

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