

## Supplemental Information

### Experimental

#### General procedures

Kevlar was synthesised according to published procedure.<sup>1</sup> Thin Multi-walled nanotubes were purchased from Nanocyl. All other chemicals were purchased from Sigma-Aldrich.

The ultra-sonic tip used was Model CV33 with ¼ inch tip. The ultra sonic processor used was model GEX750. The ultrasonic bath used was a Grant XB6 at 50 Hz.

The transmission electron microscopy (TEM) images were taken on a Hitachi H-7000 electron microscope. The samples were prepared by deposition and drying of a drop of the sample dispersed in ethanol onto a formvar coated 400 mesh copper grid. The scanning electron microscopy (SEM) images of the samples were obtained using a Hitachi S-4300 scanning electron microscope, which was operated from 5.0 kV to 20 kV depending on the sample used and coating required. Non-conductive samples were coated a gold-palladium alloy to a coating thickness of 10-15nm. Room temperature Raman spectra were measured with a Reinshaw 1000 micro-Raman system. The excitation wavelength was 632 nm from an AR<sup>+</sup> ion laser (Laser Physics Reliant 150 Select Multi-Line) with a typical laser power of approximately 20mW in order to avoid excessive heating. The 100x magnifying objective of the Leica microscope was capable of focusing the beam into a spot of approximately 1 µm diameter. The thermal gravimetric analysis (TGA) was carried out on a Perkin Elmer Pyris 1 TGA. Samples were burned in a flowing air environment at 20 ml/min. They were burned over a temperature range from 30°C to 900°C at a rate of 10°C/min. Testing for polymer films was carried out on a Zwick 100 tensile tester with a load cell of 100N, jaw spacing of 10mm with a strain rate of 250mm/min.

#### Synthesis of Kevlar coated nanotubes

Nanotubes (0.2g) were refluxed with Kevlar prepared above (0.4g) in a mixture of nitric acid (70ml) and sulphuric acid (20ml) for 2 hours at 100°C. The product was filtered by Buchner filtration and washed with water (2x10ml) and then acetone (2x10ml) and dried in air. The end product was Kevlar functionalised nanotubes. Nanotubes were analysed by IR, Raman, thermo-gravimetric analysis and transmission electron microscopy.

### Preparation of PVC composite films

The different concentrations of PVC polymer films were prepared using nanotube dispersions of different concentrations, to which polymer was added. Nanotubes were dispersed in N-Methyl-2-Pyrrolidinone (NMP) (20ml) using the GEX750 ultrasonic tip for 10 minutes at 150W (20%). 300 mg of PVC was slowly added to each mixture and dissolved by sonicating for a further 10 minutes. Mixtures were created where the mass percentage of nanotubes to polymer was 2%, 1%, 0.5%, 0.25%, 0.125%, 0.0675%. 3.8ml of each of these mixtures was extracted and dropped on to separate glass rectangular slides with the dimension's 25 mm x 75 mm. The films were left over-night in a vacuum oven at 60°C. Pure PVC films were also prepared by the same method for comparison. Kevlar-functionalised nanotube composite PVC films were prepared using the same concentrations and methods.

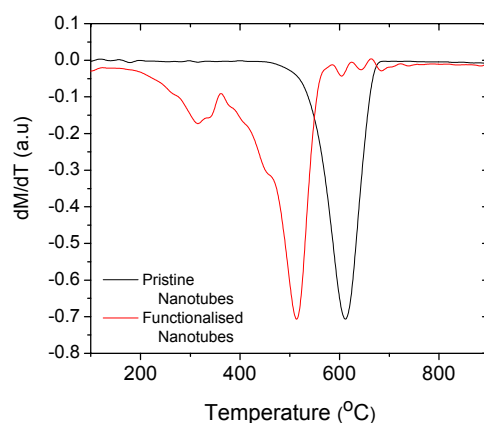


Fig. S1. Thermogravimetric analysis curves for both pristine nanotubes (black) and functionalised nanotubes (red).

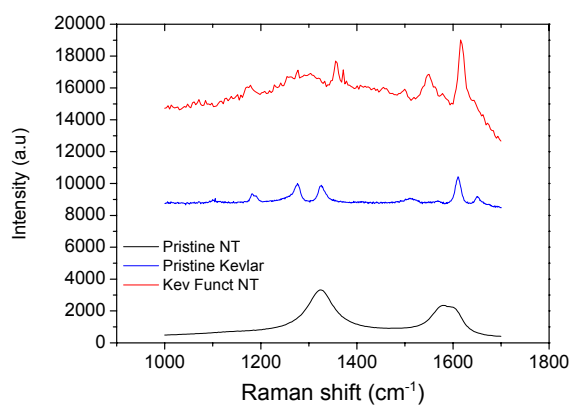


Fig. S2. Raman spectra for pristine nanotubes (black), pure Kevlar (blue) and functionalised nanotubes (red), spectra are lifted for clarity.

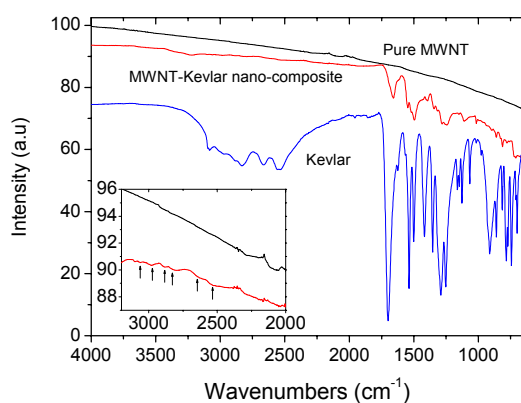


Fig. S3. Infrared spectroscopy spectra for pristine nanotubes (black), pure Kevlar (blue) and functionalised nanotubes or nano-composite (red). The inset illustrates corresponding weak Kevlar peaks, which are present in the nano-composite spectrum.

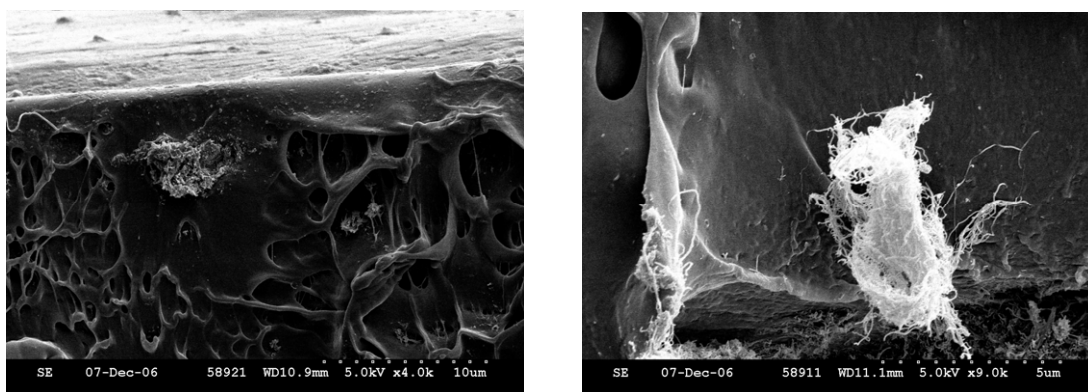


Figure S4. SEM images of cross-section of PVC-pristine nanotube composite films. The images show quite large aggregates of carbon nanotubes inside polymer films.

<sup>1</sup> B. Jingsheng, Y. Anji, Z. Shengqing, Z. Shufan, H. Chang. *J. Appl. Polym. Sci.* 1981, **26**, 1211