Supporting Information for

High strength composite fibres from polyester filled with nanotubes and graphene

Umar Khan, Karen Young, Arlene O’Neill and Jonathan N Coleman*

Centre for Research on Adaptive Nanostructures and Nanodevices and School of Physics, Trinity College Dublin, Dublin 2, Ireland

*colemaj@tcd.ie

Volume fraction dependence for SWNT-PET composites

Figure S1: Young’s modulus and ultimate tensile strength as a function of nanotube volume fraction for fibres with a range of mean diameters from 5.0 to 8.1 μm.
Figure S2: Strain at break and tensile toughness as a function of nanotube volume fraction for fibres with a range of mean diameters from 5.0 to 8.1 μm.

**TEM analysis of Graphene Dispersions**

It is possible to investigate the graphene dispersion using transmission electron microscopy (TEM) by dropping a small quantity of the dispersion onto holey carbon grids. Representative TEM images are shown in Figure S3.

Figure S3: TEM images of exfoliated graphene multilayers deposited from the dispersion used to prepare the PET-graphene composite melts.
TEM flake size statistics can also be found for the graphene dispersion. The flake thickness, \( N \), was measured using the edge counting method, described in detail in Small 6, 864 (see figure S4).

![Histograms of graphene flake statistics](image)

Figure S4: TEM statistics of graphene flakes centrifuged at 1000rpm where \( w \) is the width of the flake, \( L \) is the length and \( n \) is the number of graphene layers.

**Raman analysis of Graphene Dispersions**

Raman spectra for the graphene dispersion used for this work are shown in Figure S5. A reference graphite powder is shown also as a comparison. Here the D band (\( \sim 1300\text{cm}^{-1} \)) is indicative of the presence of defects. However, we note that for small flakes such as those observed here, significant D bands can come simply from the presence of flake edges (Small 6, 864).
Figure S5: Raman spectra of A) graphite powder and B) the dispersed graphene (after filtration to form a film).

Volume fraction dependence for Graphene-PET composites

Figure S6: Young’s modulus and strength as a function of graphene volume fraction for fibres with a range of mean diameters from 7 to 13 μm.
Figure S7: Strain at break and tensile toughness as a function of graphene volume fraction for fibres with a range of mean diameters from 7 to 13 μm.