

Supporting information

One-pot approach to prepare high-performance graphene-reinforced poly(vinyl chloride) using lithium alkyl as covalent bonding agent

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5 Characterization of p-GS

AFM (SPI3800N microscope, Seiko Instruments, Inc.) is used to access the morphology and numbers of graphene layers as shown in Figure S1. The samples were prepared by depositing a dispersion of p-GS in THF onto a freshly cleaved silicon surface. The cross-sectional profile of the AFM image (Figure S1) shows that the average thickness of a p-GS sheet is about 0.7 nm, which is typical for one-atom-thick graphene. Figure S2 shows the C 1s XPS spectra of p-GS, four different peaks centered at 284.5, 285.6, 287.3 and 289.2 eV are observed, corresponding to C-C in the aromatic rings, C-O of epoxy and alkoxy, C=O and O-C=O groups respectively, but the peak intensities of all carbons binding to oxygen are extremely lower than that of C-C.

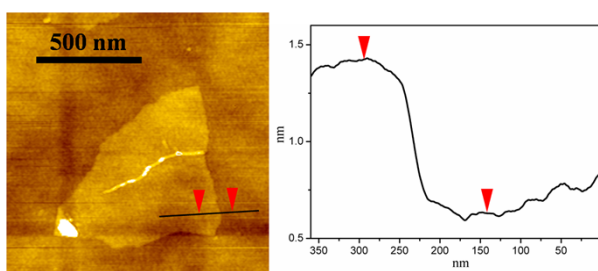


Fig. S1 AFM image of p-GS with height profile

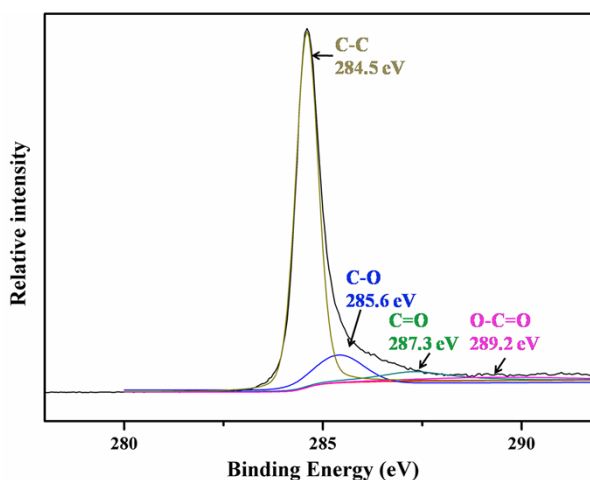


Fig. S2 XPS spectra of pristine graphene

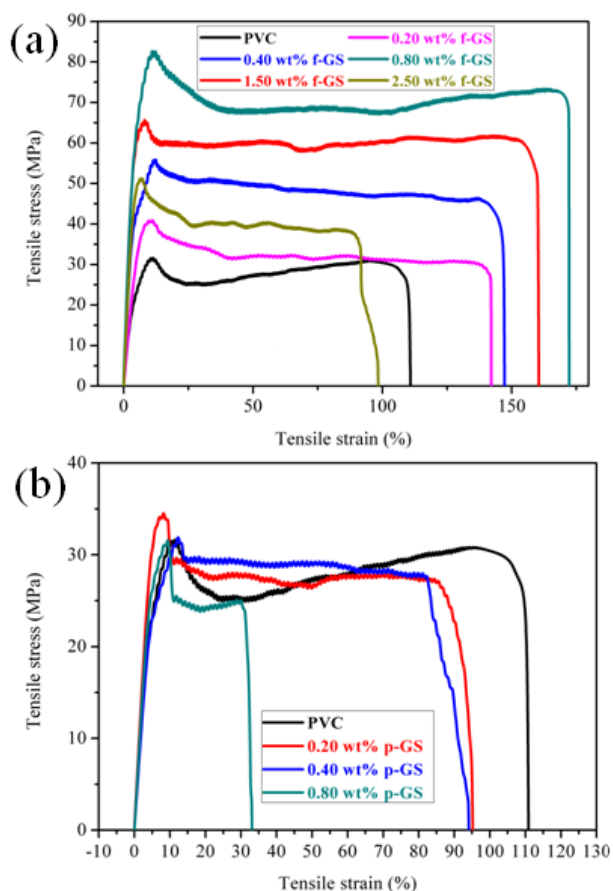


Fig. S3 Representative stress-strain behavior for PVC/graphene nanocomposites with different graphene weight loadings (a) with f-GS; (b) with p-GS.

Synthesis of modified Graphene

- 5 Graphene oxide (GO) was prepared with improved Hummers' method[1], and synthesis of modified graphene was realized according to the previously published procedure.[2] A typical procedure for preparing GO is as follows: a 9:1 mixture of concentrated H_2SO_4/H_3PO_4 (360:40 mL) was added to a mixture of graphite flakes (3.0 g, 1 wt equiv) and $KMnO_4$ (18.0 g, 6 wt equiv). The reaction was then heated to 50 °C and stirred for 12 h. The reaction was cooled to room temperature and poured onto ice (400 mL) with 30% H_2O_2 (3 mL). After multiple-wash process, the obtained solid was vacuum-dried at room temperature.
- 10 The GO (2.5 g) was dissolved and exfoliated in 800 mL deionized water via ultrasonication, the resulting suspension was mixed with the solution of n-octadecylamine (3.5 g) in 150 mL ethanol in a three-neck flask. The mixture was refluxed with magnetic stirring for 20 h at 90 °C, then 2.5 g hydroquinone was added, and the mixture was refluxed for another 20 h to reduce it to graphene-octadecylamine (GE). The mixture was then purified with centrifugation and dried in an oven at 80 °C for 24 h. The comparisons (GO) were executed the same procedure without hydroquinone.
- 15 **Preparation of PP Composites with GE (or GO)**

PP composites were prepared by solution blending. Typically, GE (or GO) was dispersed and exfoliated in toluene by the ultrasonicator for 0.5 h. The resulting suspension was mixed with PP, which were dissolved in toluene at 120 °C. After the mixture was homogenized at ambient temperature for 0.5 h, it was poured into a Teflon Petri dish and kept at 50 °C for film formation until its weight equilibrated. A series of PP nanocomposite films were peeled off of the substrate, 1.5 mm thick circular disks by compression molding at 180 °C and 10 20 psi for 5 min.

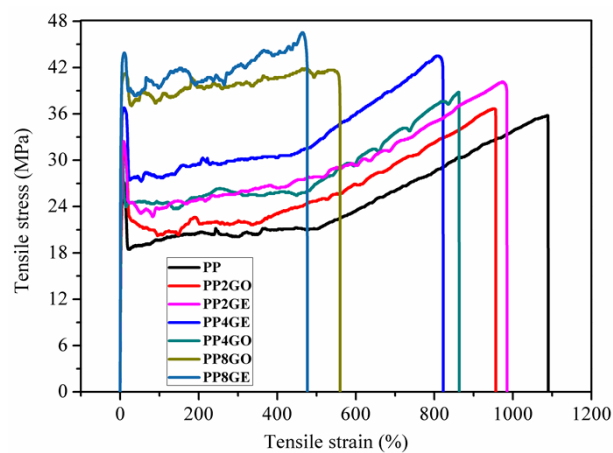


Fig. S4. Stress-strain behavior for PP nanocomposites with different GE and GO weight loadings.

Table S1. Mechanical properties of PP composites.

Samples	GE (or GO) (wt %)	Yield strength (MPa)	Tensile strength (MPa)	Elongation at break (%)
PP	0	32.1±0.2	35.8±0.3	1080±58
PP2GO	2	30.8±0.4	36.7±0.5	956±44
PP2GE	2	32.5±0.3	40.3±0.2	984±66
PP4GO	4	30.0±0.3	38.9±0.2	861±42
PP4GE	4	36.9±0.4	60.2±0.4	810±65
PP8GO	8	41.2±0.5	41.7±0.7	551±72
PP8GE	8	44.1±0.4	46.6±0.5	469±33

5 References

- 1 D. C. Marcano, D. V. Kosynkin, J. M. Berlin, A. Sinitskii, Z. Sun, A. Slesarev, L. B. Alemany, W. Lu, J. M. Tour, *ACS Nano* 2010, **4**, 4806.
- 2 G. Wang, X. Shen, B. Wang, J. Yao, J. Park, *Carbon* 2009, **47**, 1359.