Electronic Supplementary Information (ESI)

Dispersibility of Different Sized Graphene Oxide Sheets and Their Reinforcement on Polyamide 6 Fibers

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1. Supplementary Calculation

Size polydispersity (SPD) of GO sheet was calculated according to Equation (1).

$$SPD = \frac{STD}{\mu} \quad (1)$$

$$STD = \sqrt{\frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N}} \quad (2)$$

Note：STD represents Standard Deviation of GO sheet size based on SEM images calculated according to Equation (2); μ is the mean size of GO sheets in the SEM images; X_i is the size of one GO sheet in the SEM images; N is the total number of GO sheets in the SEM images.

2. Supplementary Synthetic Method

Fe_3O_4 nanocrystallines anchored on GO sheets were synthesized by a simple hydrothermal method.[1] In this synthesis process, 100 mg GO was dispersed in 100 mL deionized water with sonication. Then, 10 mmol ferric citrate was added into the solution and stirred at 80 ^oC for 1 h to make sure of a complete combination of the metal ion and the oxygen-containing functional groups on the edges and surface of GO sheets. The resulting solution was transferred to a Teflon-line stainless steel autoclave (250 mL in volume) and heated at 90 ^oC for 12 h. After cooling down to room temperature, the product was centrifuged and washed several times by alcohol and deionized water before vacuum freeze-drying. Finally, Fe_3O_4 nanocrystallines growing uniformly on GO surface were obtained.

3. Supplementary Table

Table S1. The details of mechanical properties in PA6, CPA0.2, LPA0.2, MPA0.2 and SPA0.2 fibers.

Sample	Young's Modulus (MPa)	Yield Stress (MPa)	Tensile Strength (MPa)	Extensibility (%)	Toughness (MJ m^{-3})
CPA0.2	280.6	32.9	158.1	292.1	236.2
LPA0.2	383.5	58.5	205.8	309.5	345.8
MPA0.2	679.1	70.5	322.3	348.2	544.2

SPA0.2	1048.2	96.1	423.1	364.4	771.9

4. Supplementary Figures

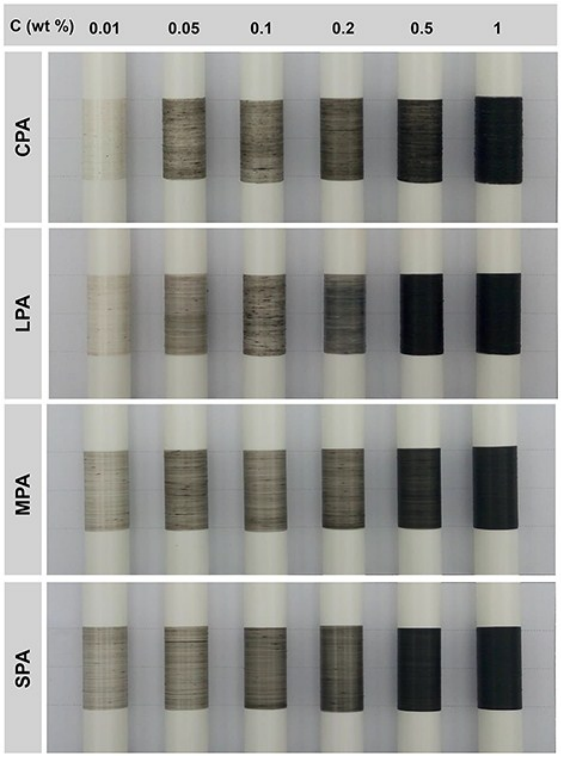

Fig. S1. PA6/g-GO nanocomposite fibers containing CGO, LGO, MGO and SGO sheets at different loadings continuously melt-spun and collected on spools.

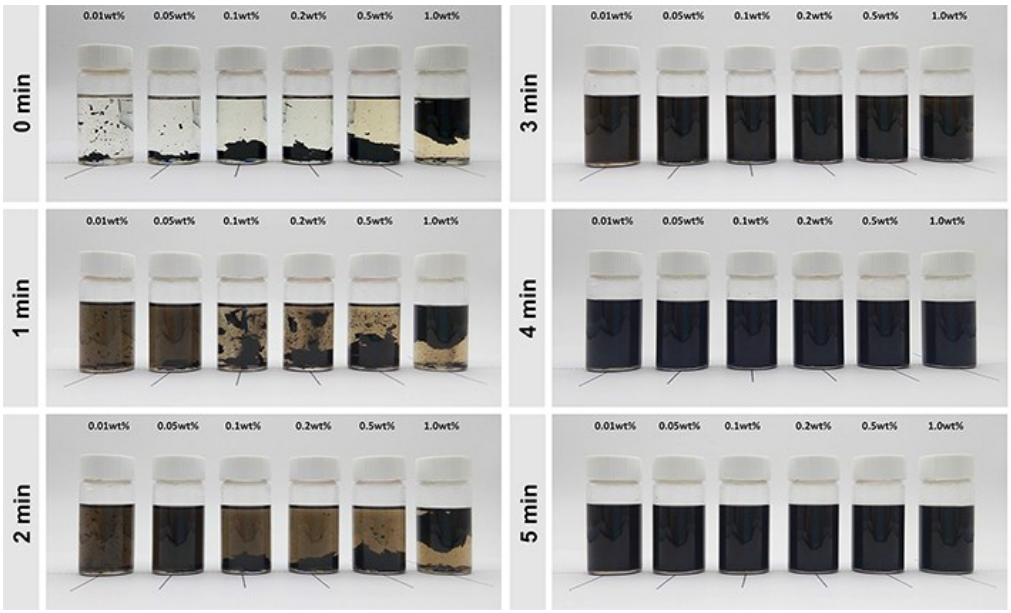

Fig. S2. Digital photographs of SGO sheets in CPL melt at different loadings at 90 ^{o}C for various sonication time: 0 min, 1 min, 2 min, 3min, 4 min and 5 min.

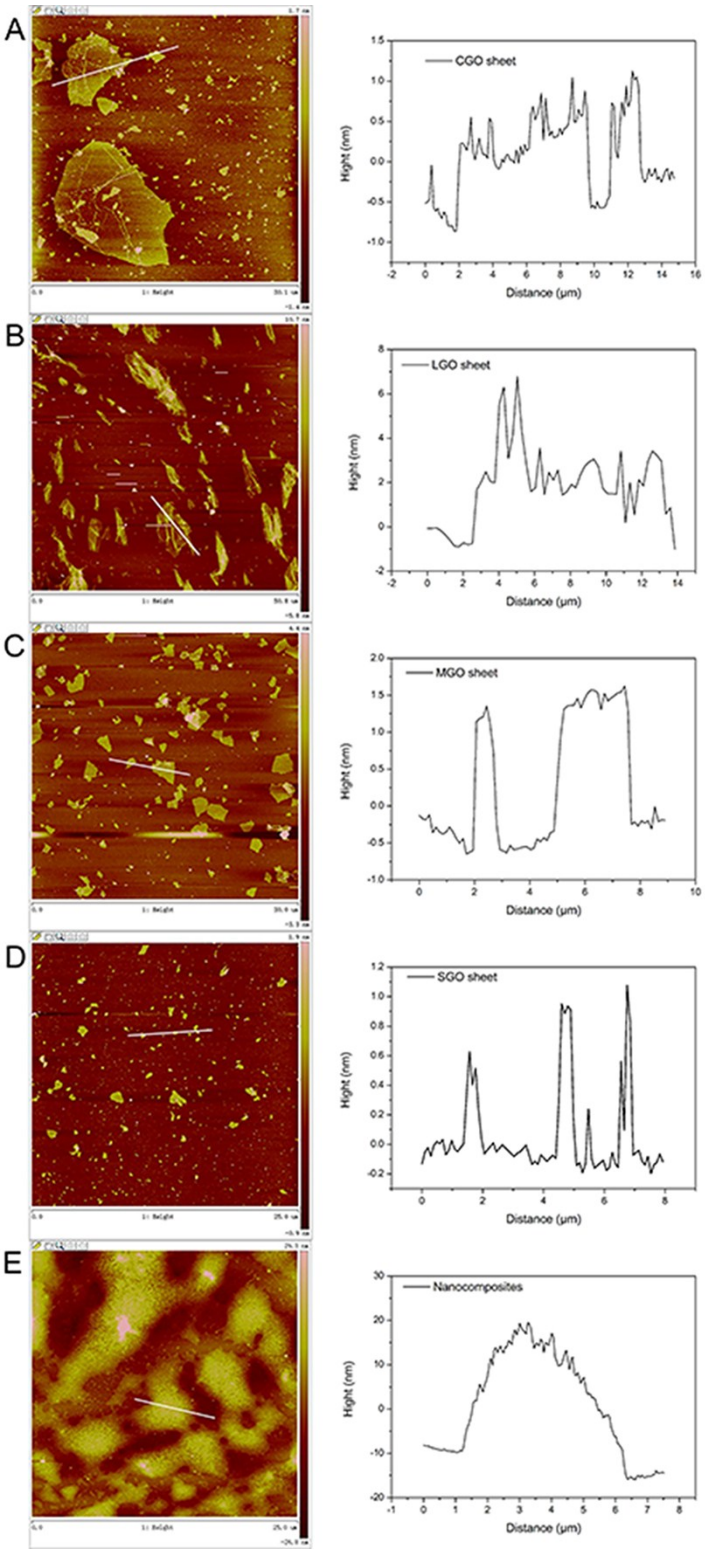

Fig. S3. Typical AFM images of (A) CGO, (B) LGO, (C) MGO, (D) SGO, (E) g-MGO specimens. The thickness of different sized GO sheets is about 1 nm, suggesting effective size fractionation of different sized GO sheet with Single-layer or few layer structure, while the thickness of g-MGO sheets increases to about 25 nm, suggesting PA6 chains have obviously combined with g-GO.

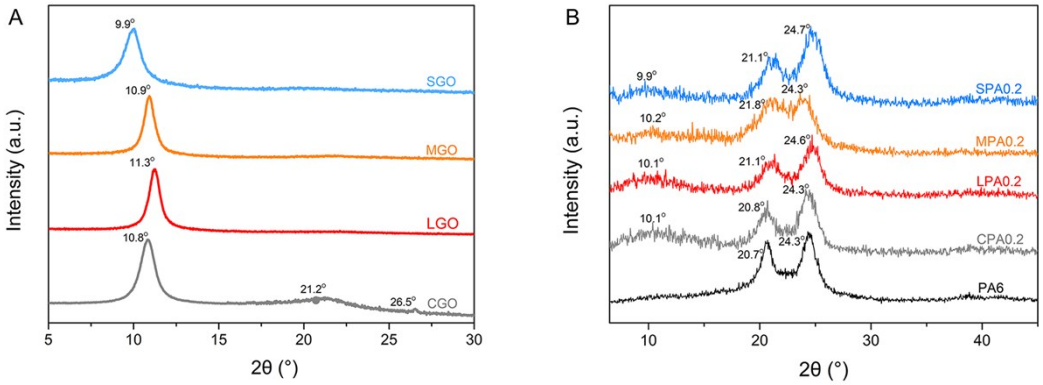

Fig. S4. (A) XRD patterns of CGO, LGO, MGO and SGO specimens； (B) XRD patterns of PA6, CPA0.2, LPA0.2, MPA0.2 and SPA0.2 nanocomposites.

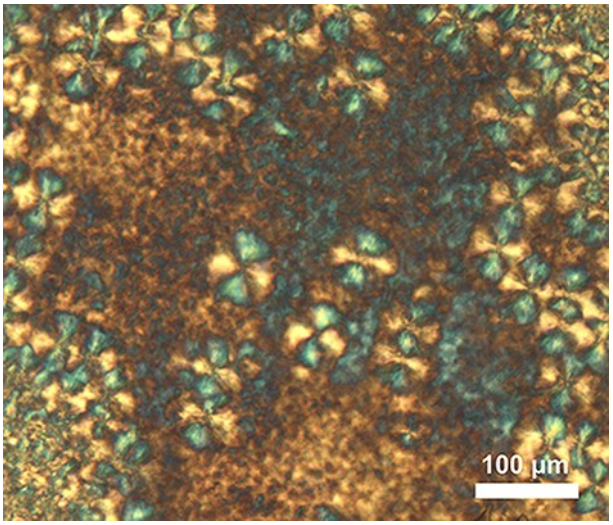

Fig. S5. Representative polarized optical image of PA6. It is shown obvious cross extinction phenomenon in pure PA6 matrix.

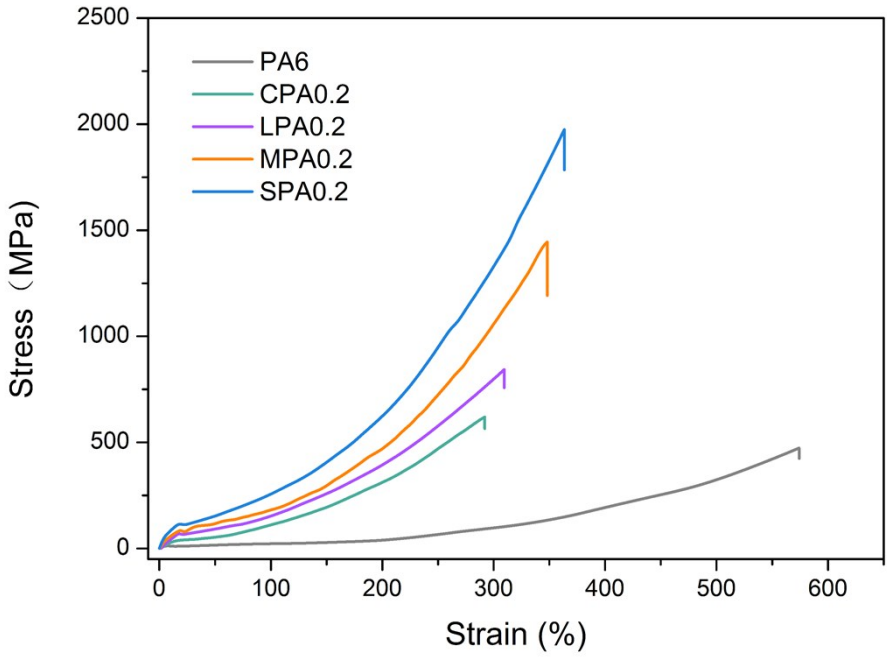

Fig. S6. Ture stress-strain curves for the nanocomposite fibers containing different sized GO at the same loading (0.2 wt%). The true stress-strain curves are obtained from the calculated results according to the literature[2] based on Figure 7A, which is used to verify true mechanical properties with the change of fiber linear density during the measurement.

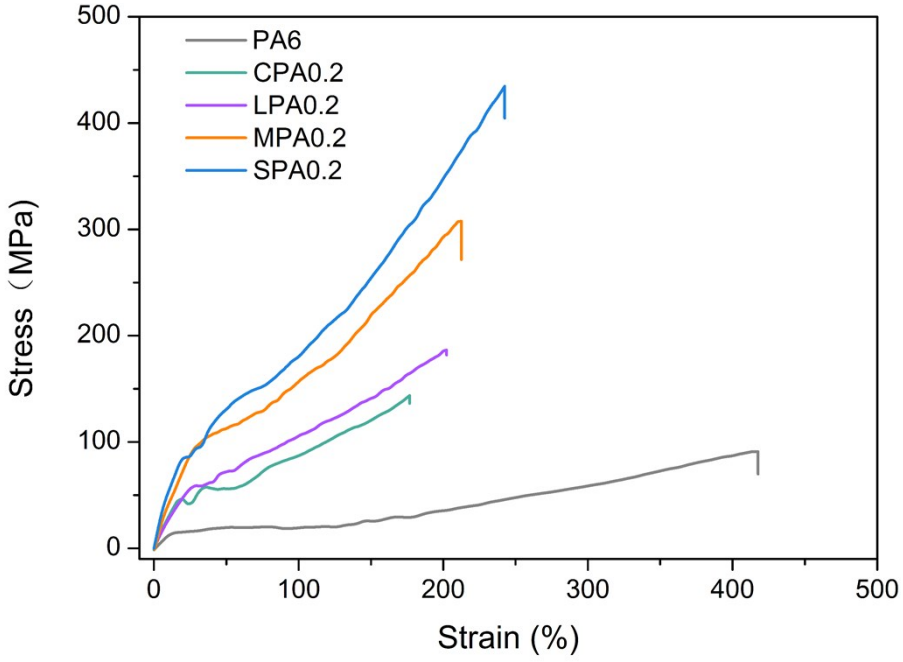

Fig.S7. Knot stress-strain curves for the nanocomposite fibers containing different sized GO at the same loading (0.2 wt%). Knot stress-strain curve is measured using a sample fiber with a knot, which is used to verify mechanical properties of the fiber under shear stress.

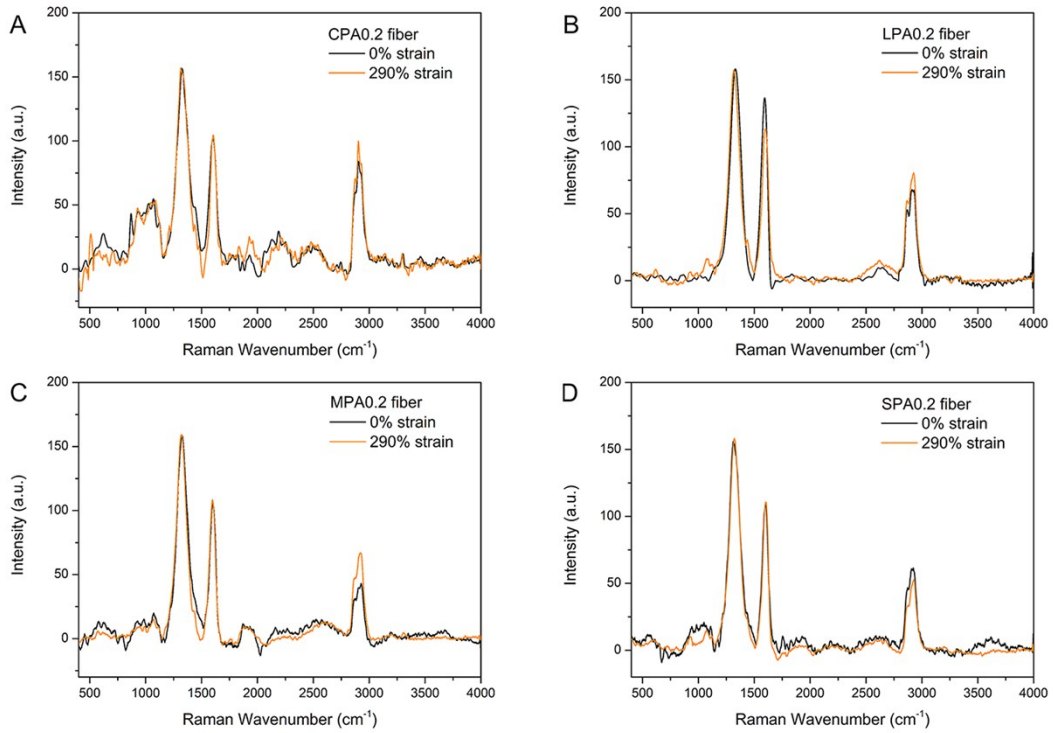

Fig.S8. The full range (4000-400 cm^{-1}) of Raman spectra of prepared samples for (A) CPA0.2, (B) LPA0.2, (C) MPA0.2 and (D) SPA0.2 nanocomposite fibers.

References

1. Y. C. Dong, R. G. Ma, M. Jun Hu, H. Cheng, C. K. Tsang, Q. D. Yang, Y. Yang Li and J. A. Zapien, *Journal of Solid State Chemistry*, 2013, **201**, 330-337.
2. I. Faridmehr, M. Hanim Osman, A. Bin Adnan, A. Farokhi Nejad, R. Hodjati and M. Amin Azimi, *American Journal of Civil Engineering and Architecture*, 2014, **2**, 53-59.