Supporting information

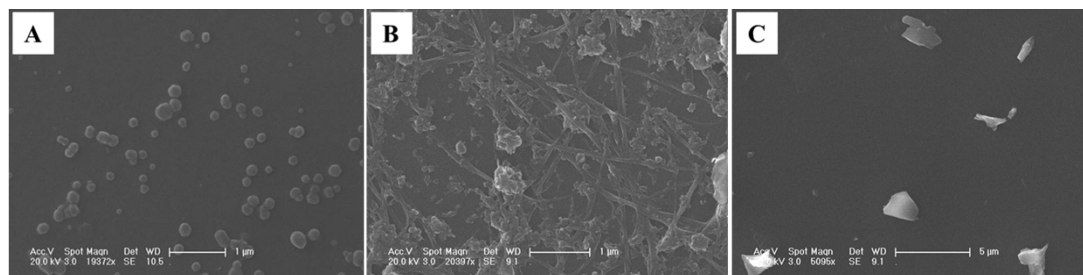## 1. Characterization of nanoparticles with different dimensions

Fig. S1 SEM images of CNP, CNT and GO after ultrasonication treatment for 2 hours. CNP (A), CNT (B) and GO (C)

2. Calculation of the velocity of nanoparticles with different dimensions under ultrasonication

During the ultrasonication, the particle was exerted an average pressure P by shock wave as it passes over particles in near proximity to the collapsed bubble. This pressure exerts a force proportional to the particle's cross-section area, $F=\pi R^2 P$. According to Stokes law, $F_d = 6\pi\eta R v$ in a laminar flow regime. We could solve the simple Newtonian equation, $ma=\pi R^2 P - F_d$.

In this work, CNT could be supposed as prolate ellipsoid.

For CNT, r=1nm, B=2nm, A=2μm. Compared with the same volume of CNT, the radius of sphere could be calculated as 11nm.

Perrin Shape Factor: k = f / f_{sphere} could calculate k for prolate ellipsoids[1].

When ($A>B$), A/B=1000

$$k = \frac{f}{f_0} = \frac{[1-(B/A)^2]^{1/2}}{(B/A)^{2/3} \ln\{\frac{1+[1-(B/A)^2]^{1/2}}{B/A}\}} = 14.5$$

For CNT, Stokes Law becomes: $f = k6\pi\eta r_{sphere} v$.

When the particle was pushed by shock wave, the velocity increased until constant speed. Therefore a=0, $F - 14.5 \times F_d = 0$

For CNT: $\pi r^2 P = 14.5 \times 6\pi r\eta v$, $v_{CNT} = \dfrac{rP}{6\eta \times 14.5} = 0.07\dfrac{P}{6\eta}$

For sphere particle: $\pi R^2 P = 6\pi R\eta v$, $v_{sphere} = \dfrac{RP}{6\eta} = 11\dfrac{P}{6\eta}$

According to the Kenneth S. Suslick's work [1], when the radius of the sphere particle was smaller than 14 μm, the velocity of the particle increased with the increase of the size of the particle. In this work, we take that result as approximate reference. Hence the velocity relationship between CNP and CNT was $v_{CNP} > v_{sphere} > v_{CNT}$.

3. Raman Characterization of different nanoparticles before and after ultrasonication process

Fig. S2-S4 are the Raman spectra of CNP, CNT and GO before and after ultrasionication for 2 h. The peak at 1574 cm^{-1} is attributed to G band, corresponding to the in-plane vibrations of sp^2 bonded carbon atoms. D band appears at 1341 cm^{-1}, which is attributed to the disordered structures. The ratio of I(D)/I(G) can be used as an indication of defects quantity. From Table S1, for three samples the slight increase in I(D)/I(G) ratio after ultrasonication is attributed to the structure of CNP, CNT and GO were partially destroyed by the mechanical shock waves and shear forces created by the collapse of cavitation bubbles during ultrasonication.
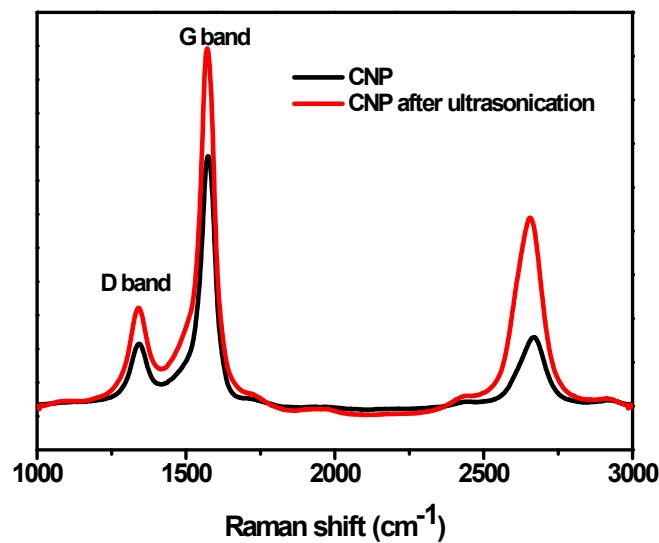

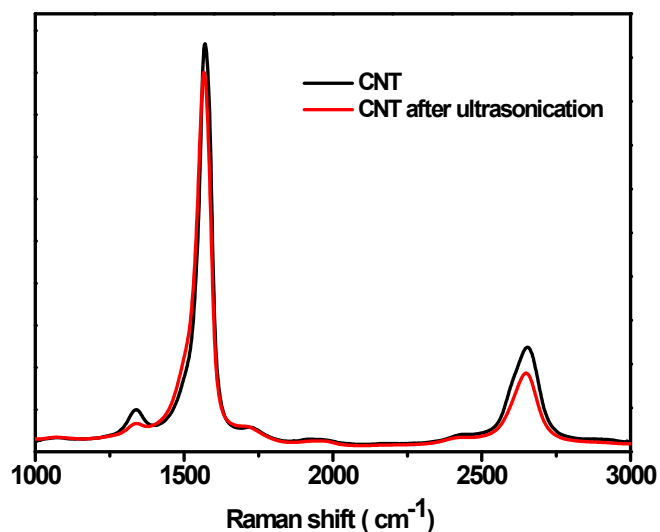Fig. S2 Raman spectra of CNP before and after ultrasonication

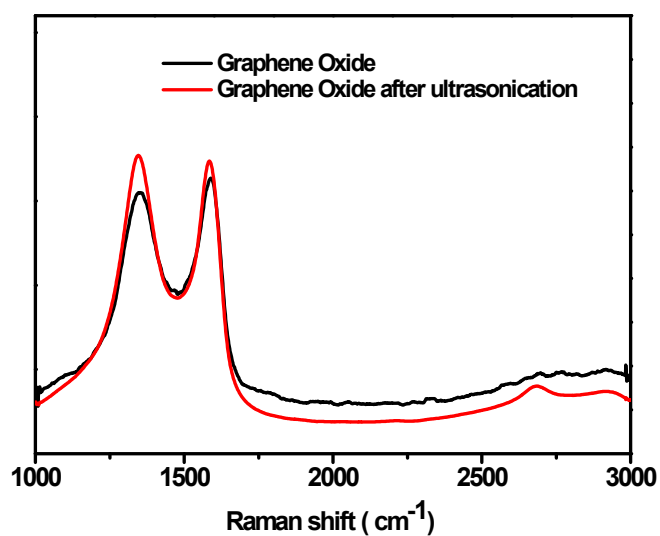Fig. S3 Raman spectra of CNT before and after ultrasonication

Fig. S4 Raman spectra of GO before and after ultrasonication

Table S1: I_D/I_G for the CNP, CNT and GO before and after ultrasonication

	CNP	CNP□	CNT	CNT□	GO	GO□
I_D/I_G	0.10	0.16	0.09	0.13	0.94	1.05

"□" stands for the sample after ultrasonication.

1.   Prozorov, T., R. Prozorov, and K.S. Suslick, *High Velocity Interparticle Collisions Driven by Ultrasound.* Journal of the American Chemical Society, 2004. **126**(43): p. 13890-13891.