SUPPORTING INFORMATION

Synthesis of graphene oxide (GO)

Graphite oxide was synthesized from graphite power (spectral pure, Sinopharm Chemical Reagent Co., China) according to a modified Hummers' method.[1-3] Graphite powder (3 g) was put into an 80 °C solution of concentrated H_2SO_4 (12mL), $K_2S_2O_8$ (2.5 g), and P_2O_5 (2.5 g). The mixture was kept at 80 °C for 4.5 h using a hotplate. Successively, the mixture was cooled to room temperature and diluted with 0.5 L of de-ionized (DI) water and left overnight. Then, the mixture was filtered and washed with de-ionized (DI) water using a 0.2 micron Nylon Millipore filter to remove the residual acid. The product was dried under ambient condition overnight. This pre-oxidized graphite was then subjected to oxidation by Hummers' method described as follows. Pretreated graphite powder was put into cold (0 °C) concentrated H_2SO_4 (120 mL). Then, $KMnO_4$ (15 g) was added gradually under stirring and the temperature of the mixture was kept to be below 20 °C by cooling. Successively, the mixture was stirred at 35 °C for 2 h, and then diluted with DI water (250 mL). Because the addition of water in concentrated sulfuric acid medium released a large amount of heat, the addition of water was carried out in an ice bath to keep the temperature below 50 °C.

After adding all of the 250 mL of DI water, the mixture was stirred for 2 h, and then additional 0.7 L of DI water was added. Shortly after the dilution with 0.7 L of water, 20 mL of 30% H_2O_2 was added to the mixture, and the color of mixture changed into brilliant yellow along with bubbling. The mixture was filtered and washed with 1:10 HCl aqueous solution (1 L) to remove metal ions followed by 1 L of DI water to remove the acid. The resulting solid was dried in air.

The exfoliation of graphite oxide was carried out in 0.2% Triton X-100 to formed stable and bright brown dispersions (Fig. S1 a), as opposed to the conventional chemical routes. We characterized the morphology of as-prepared GO samples by tapping mode atomic force microscope (AFM) studies (Fig. S1b), which revealed that the thickness of GO is of ~1.1 nm, being somewhat larger than the interlayer spacing of GO (0.83 nm) measured by XRD (Fig. S2). This is due to the solvent water inserting the interlayer of GO.[4] The lateral size of single-layer GO is typically near 10 μ m, the exfoliation without surfactants typically result in GO with a size ranging from 200 nm to several micrometers.[5] TEM (Fig. S1c) obviously shows that some typical GO sheets have lateral dimensions above 40 μ m and there contains some crinkles and multiple folds on the surface.

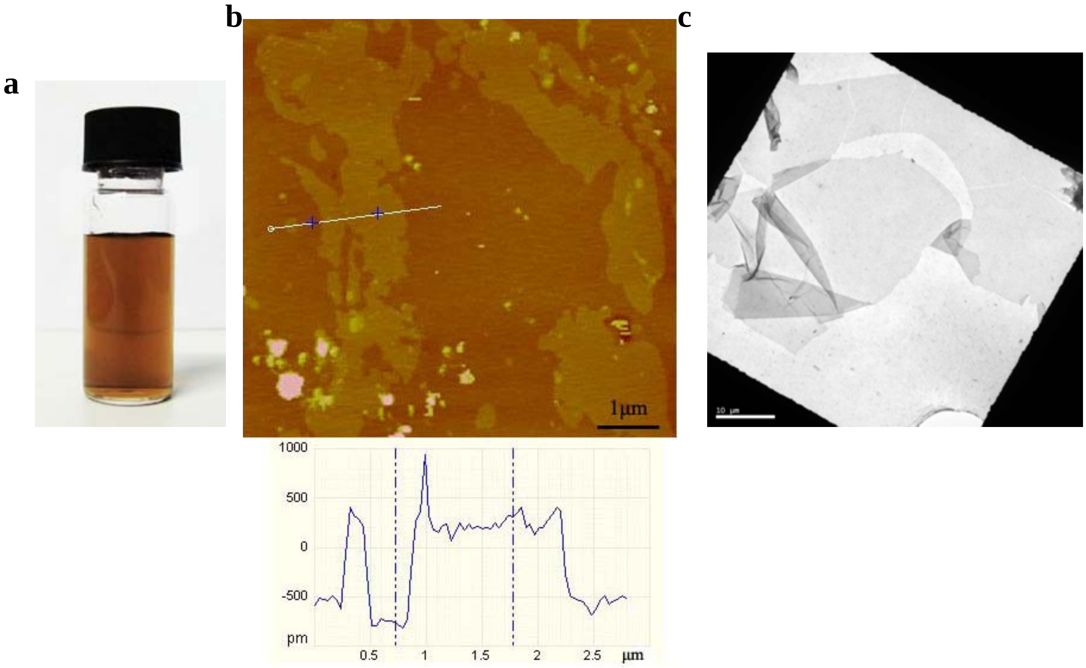

Figure S1. (a) Photographs of GO dispersion in aqueous solution, (b) AFM images and height profiles of GO, (c) TEM image of GO.

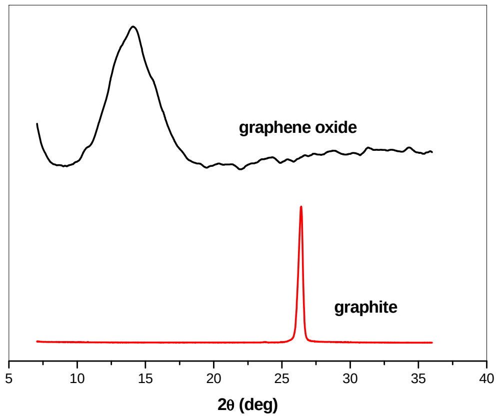

Figure S2. XRD patterns of graphite oxide (black) and graphite (red).

Figure S2 shows XRD patterns of graphite oxide and natural graphite. The pattern of graphite oxide reveals a sharp 002 reflection at $2\theta = 10.4°$, corresponding to a *c*-axis spacing of 0.83 nm. The most intense peak for graphite at $2\theta = 26.4°$ (corresponding to a *d*-spacing of 0.33 nm) is absent in graphite oxide sample. After oxidation, the interlay space of graphite oxide is larger than that of the graphite, as a result of the introduction of oxygenated functional groups on carbon sheets.

FT-IR spectrum of graphite oxide illustrated in Figure S3 also confirms the successful oxidation of graphite. The characteristic vibrations of graphite oxide are the broad and intense peak of O–H groups centered at 3386 cm^{-1}, strong C=O peak at 1724 cm^{-1}, the aromatic C=C peak at 1618 cm^{-1}, the C–OH stretching peak at 1205 cm^{-1}, and the C–O stretching peak at 1050 cm^{-1}. The peak at 1618 cm^{-1} was assigned to the vibrations of the adsorbed water molecules and also the contributions from the skeletal vibrations of non-oxidized graphitic domains. As for graphite, the spectrum is essentially featureless except the C=C conjugation (1558 cm^{-1}).

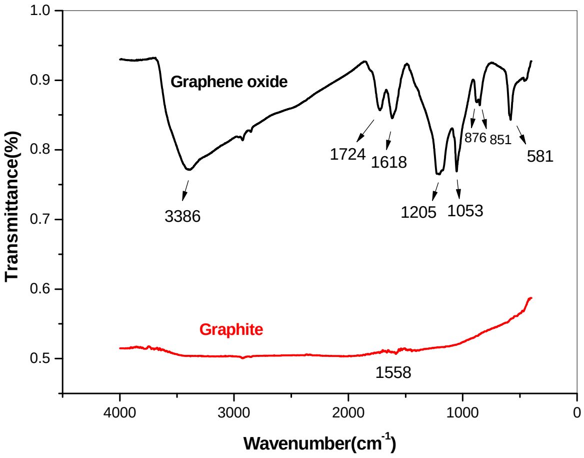

Figure S3. FT-IR spectrum of the as-prepared graphite oxide（black） and graphite (red).

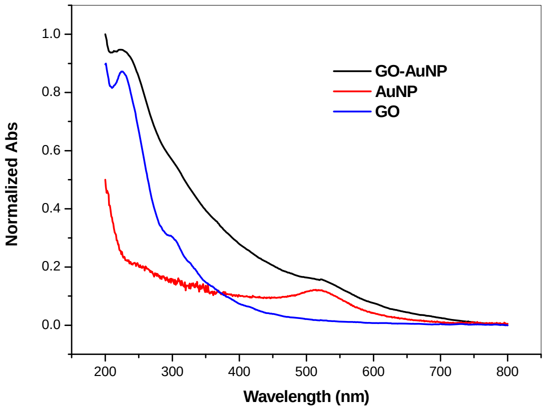

Figure S4. UV-Vis absorption spectra of GO (blue), AuNP (red) and GO-AuNP (black).

The UV-Vis spectrum of GO (Fig. S4 blue) contains a strong absorption band at 230 nm and a weak band around 290 nm, which correspond to C=C π → π* and C=O n → π* transitions, respectively.

SUPPORTING REFERENCES

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