

Photochemical synthesis of doped graphene quantum dots and their photoluminescence in aqueous and solid states
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Experimental section

20 mg of graphene oxide (GO) powders were dispersed in 100 ml of water and then 5 ml ammonia solution (37 wt%) was added into the GO solution. After ultrasonication, about 4 ml of the solution was put into a quartz cell, which was irradiated by a focused femtosecond laser (Hurricane, Spectra-Physics Lasers, 120 fs full width at half maximum, 1 kHz repetition rate) for about 30 min. The focal length of the lens is 150 mm. During laser irradiation, the magnetic stirrer was adopted to make the solution homogenous. The laser energy used for the photochemical synthesis was set to 0.5 mJ/pulse. After the fs laser photochemical processing, NGQDs were collected by filtering the resulting solution by 0.22 μm filter membrane, followed by a centrifugation at 10000 rpm to remove the larger sized graphene oxide and reduced graphene oxide nanosheets. The laser beam was focused by a lens with a focal length of $f = 150$ mm into the solution for about 30 min. Transmission electron microscopy (TEM) and high resolution transmission electron microscopy (HRTEM) images were recorded by a high resolution transmission electron microscope (JEOL, JEM2000). The ESCA 5800 XPS spectrometer was used to measure and analyze the XPS. Fourier transform infrared spectroscopy (FTIR) was performed on a Vector 22 spectrometer. Absorption spectrum was recorded on a Jasco V-570 ultraviolet/visible (UV/vis) spectrophotometer with the sample in a quartz cuvette. Excitation and emission spectrum characterizations were performed with an FLS920 fluorescence spectrophotometer. The imaging experiments of solid GQDs were carried out using an Eclipse Ti microscope (Nikon, Mississauga, ON) equipped with a 60X objective (NA = 0.7, Nikon), different filters (ET-DAPI (ex 350 ± 25 , em 460 ± 40), ET-GFP (ex 470 ± 20 , em 525 ± 40), ET-DsRED (ex 545 ± 15 , em 620 ± 50), a fluorescent lamp C-HGFI Intensilight (Nikon) and a QIClick digital CCD camera (QImaging, Surrey, BC). Spectral and images have been acquired exciting at different wavelengths after using the above filters. The emitted fluorescence is collected and sent to a set of gratings and then to a by a photodetector from Andor technology (model No. SR-750-C) and the background was subtracted. A drop of NGQDs was casted on cover slide and the NGQDs self-organized into coffee ring-like configuration during the evaporation and the images were acquired on the edge of the coffee ring.

Figures

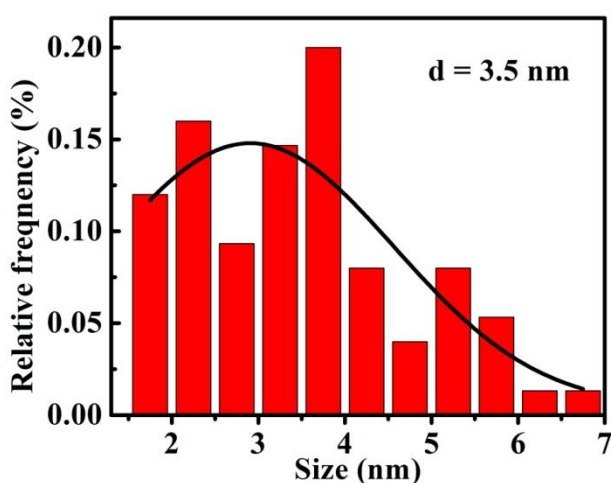


Fig. S1 Size distribution of NGQDs.

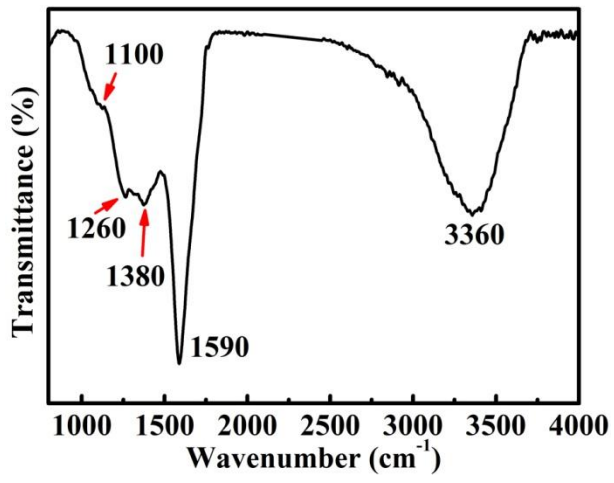


Fig. S2 FTIR spectrum of NGQDs.