Electronic Supplementary Information for

Facile synthesis of carbon quantum dots and thin graphene sheets for non-enzymatic sensing of hydrogen peroxide

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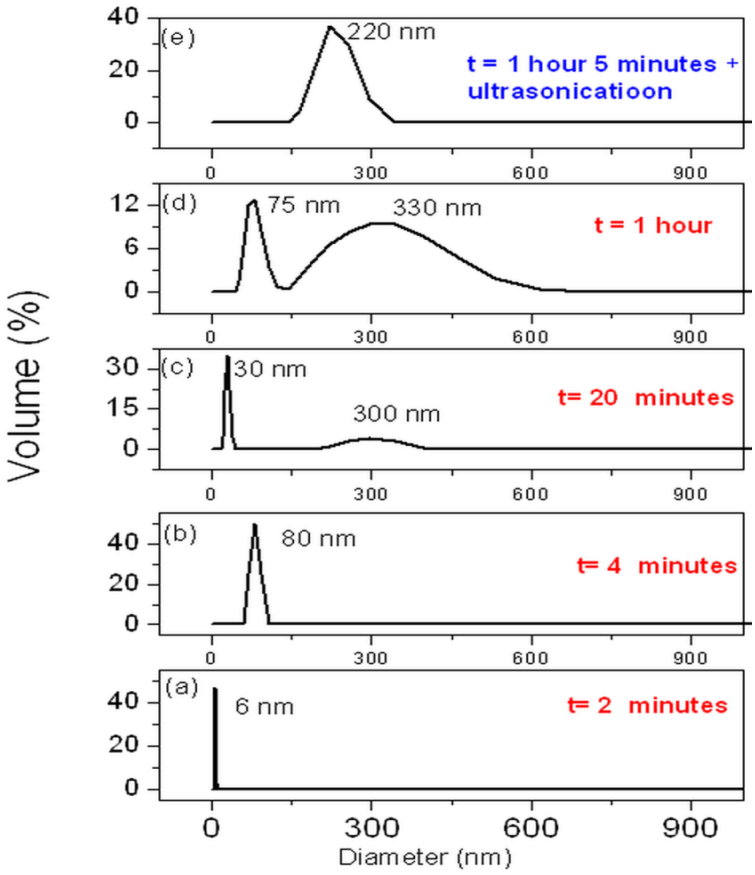

Fig. S1 Hydrodynamic diameter of CQDs in water with time and after ultra sonication. The whole product was dissolved in 20mL water and DLS measurements were performed at different time.

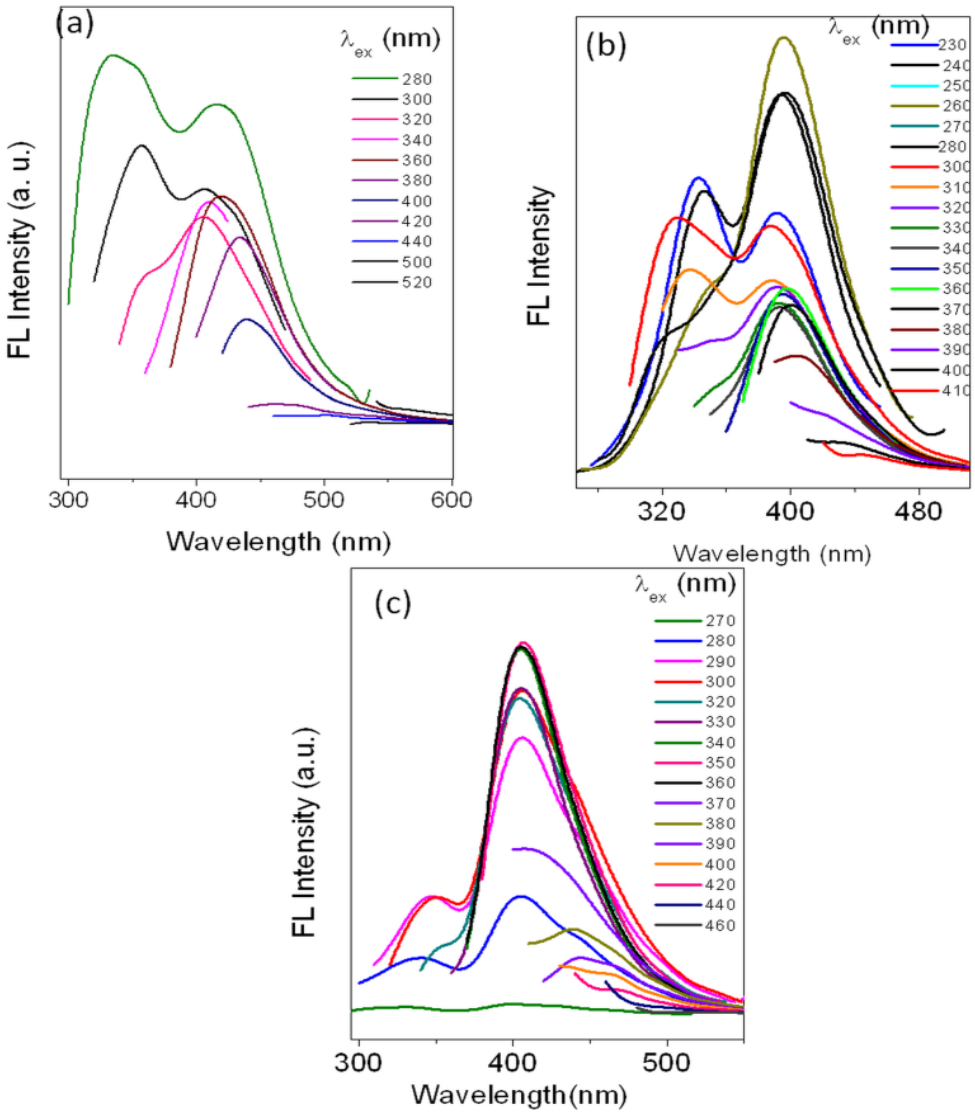

Fig. S2 Fluorescence spectra of CQDs in (a) methanol, (b) cyclohexane, (c) benzene at different excitation wavelengths.

Quantum Yield Measurements

Quantum yield of CQDs in different solvents were determined using following equation[1]:

$$\Phi_S = \Phi_R \times (I_S/I_R) \times (\eta^2_S/\eta^2_R) \times (A_R/A_S)$$

Where the Φ is the quantum yield, I is the integrated photoluminescence intensity, A is the optical density and η is the refractive index of the solvent. The subscript "S" refers to the sample, CQDs and "R" for reference. The reference was quinine sulfate in 0.1M H_2SO_4. It is well known that quantum yield of Quinine sulfate in 0.1M H_2SO_4 is 54%. The absorbance of the solution of CQDs in different solvents and reference were kept below 0.10 at the excitation wavelength.

Fluorescence life time of CQDs in different solvents

Fluorescence life times were calculated using time correlated single photon counting technique. The emission decay profiles of CQDs in different solvents are shown in Fig. 2f and Fig. S3. Decay curves were fitted using multi exponential model using the following equation[1]:

$$I(t) = \sum_{i=1}^{n} A_i \exp(-t/\tau_i)$$

Where I(t) is the intensity usually assumed to decay as the sum of individual single exponential decays, A_i are the pre-exponential factors, τ_i are the decay times. The fluorescence decay curves of CQDs in different solvents are fitted to triple exponential functions. The average life time (τ_{avg}) of CQDs were determined by

$$\tau_{avg} = \frac{\sum_i A_i \tau_i^2}{\sum_i A_i \tau_i}$$

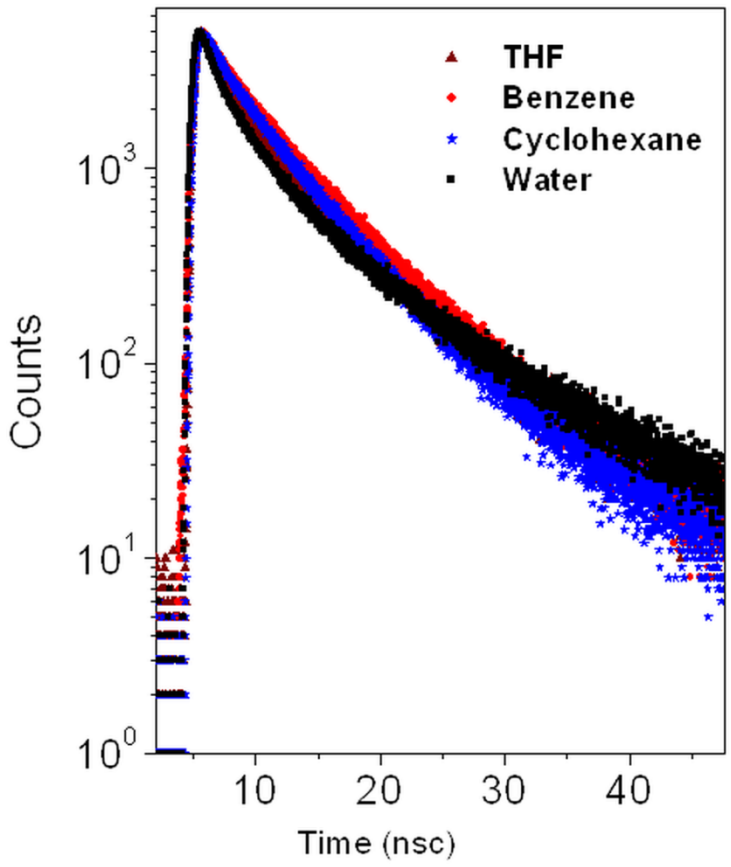

Fig. S3 Fluorescence decay curves of CQDs in water, cyclohexane, tetra hydrofuran (THF), benzene solvents.

Table S1 Fluorescence decay time (τ) and pre-exponential factor (A) of CQDs in various solvents.

Solvent	$\tau_1(A_1)$	$\tau_2(A_2)$	$\tau_3(A_3)$	τ_{avg}	χ^2
Water	0.6612(0.5155)	3.435(0.3827)	11.25(0.1018)	**6.293**	1.016
THF	0.8046(0.5217)	4.1597(0.3478)	9.1295(0.1305)	**5.6354**	1.057
Benzene	0.6364(0.2594)	3.513(0.3705)	7.368(0.3701)	**5.90**	1.016
Cyclohexane	0.7204(0.3334)	4.6727(0.619)	10.74(0.0476)	**5.263**	1.081

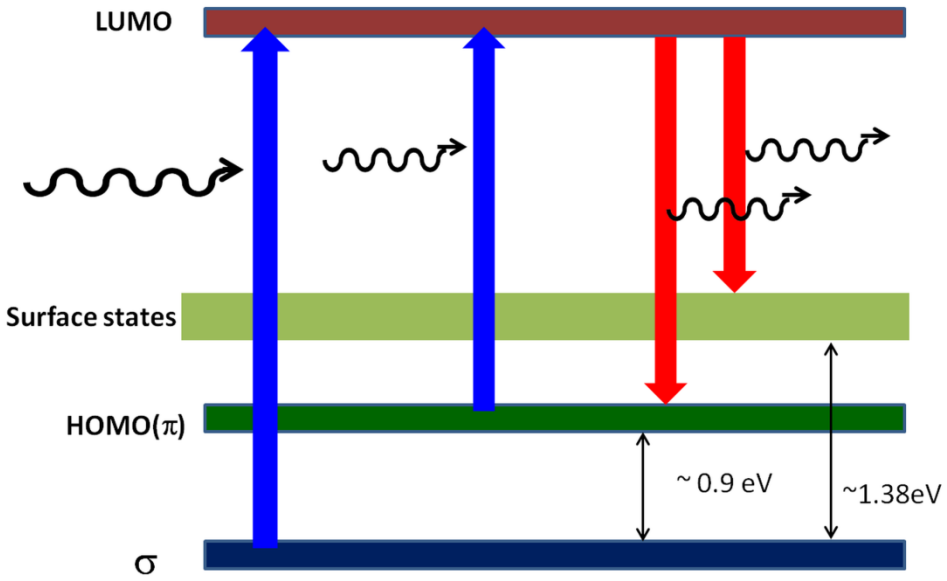

Fig. S4 Schematic diagram for electronic transitions of CQDs for fluorescence emission.

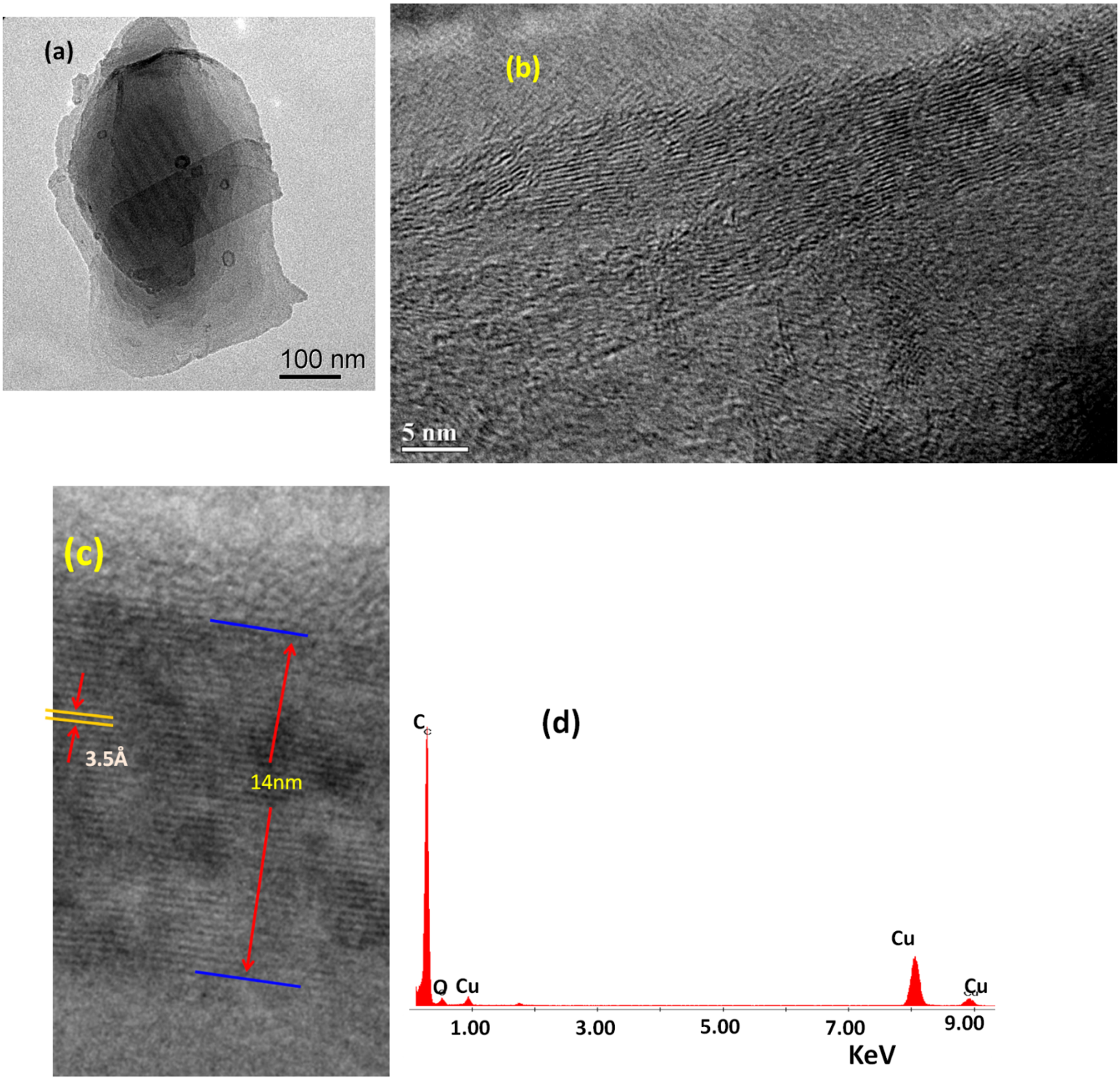

Fig. S5 (a) TEM image of two dimensional graphene sheets. A folded sheet is clearly visible. (b, c) HRTEM image of graphene sheets. 40 layers of graphene is clearly seen in (c). (d) EDX spectrum of graphene sheets.

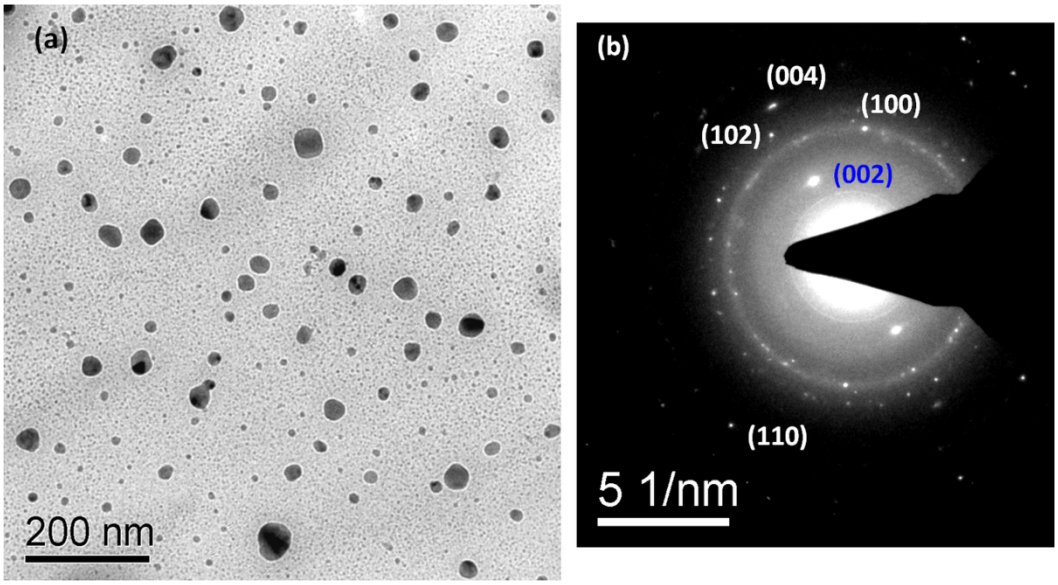

Fig. S6 TEM image and SAED image of graphite nano particle. Stock solution was diluted 100 times before TEM sample preparation. TEM sample was prepared by drop casting and evaporating a drop of CQDs solution. The interlayer spacing calculated from SAED image 3.2, 2.12, 1.80, 1.62, 1.23 Å are indexed as (002), (100), (102), (004), (110) plane of hexagonal graphite respectively based on powder X-ray data base (PDF-00-041-1487).

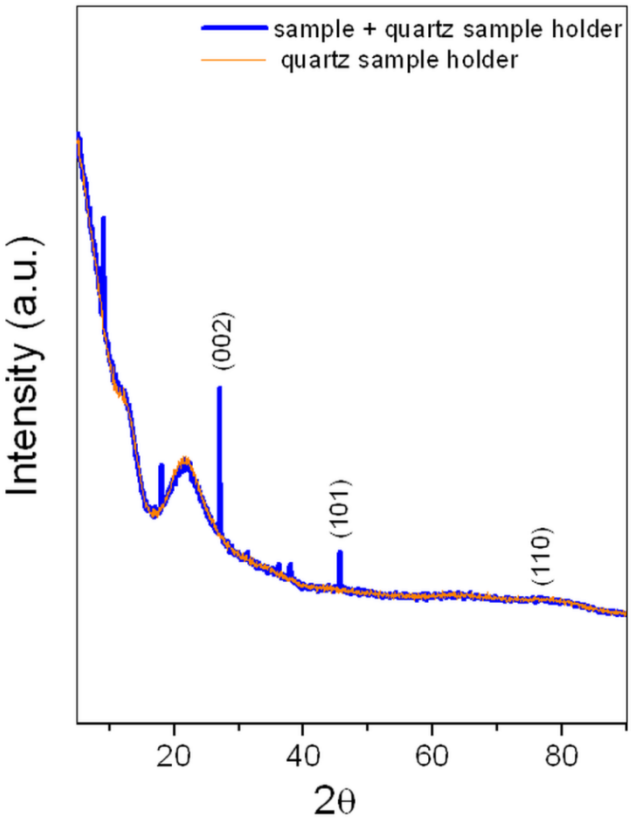

Fig. S7 p-XRD pattern of graphite/graphene. Sample was prepared by evaporating aqueous solution of CQDs on quartz.

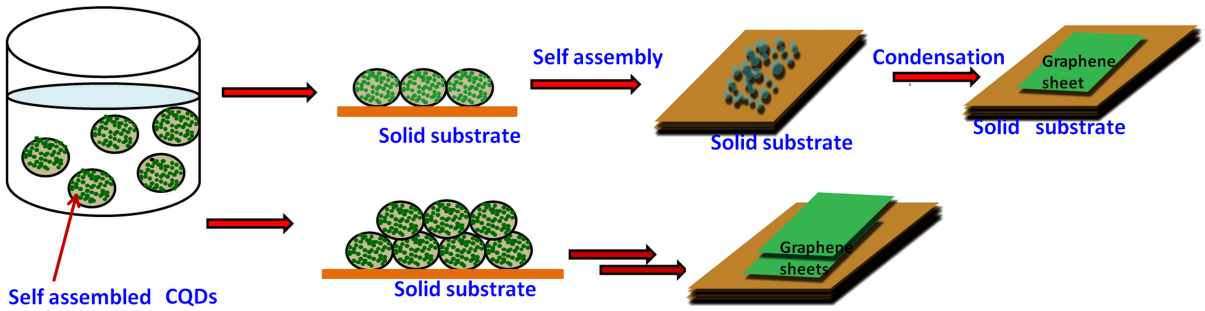

Fig. S8 Schematic diagram for the formation of 2D graphene sheets. CQDs are self assembled in aqueous solution. 2D graphene sheets are produced by evaporation induced self assembly and condensation of CQDs on a solid substrate**.**

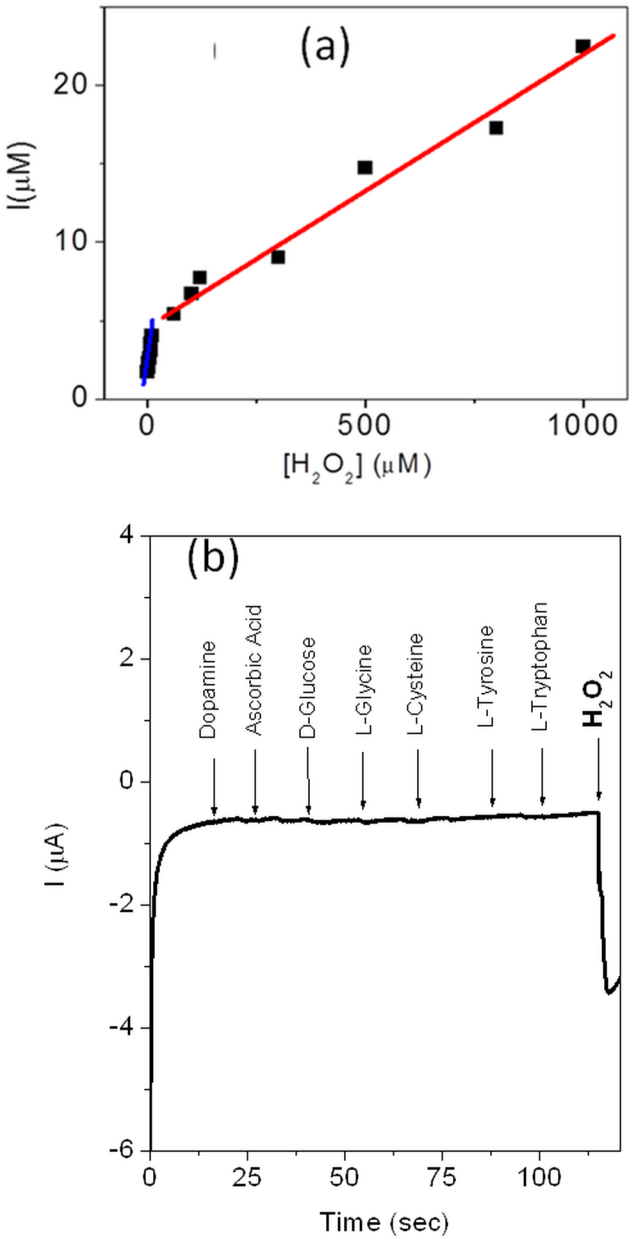

Fig. S9 (a) Calibration plot of current *vs* concentration of H_2O_2 at graphene sheets modified GC electrode. (b) Amperometric responses of graphene sheets modified GC electrode at a potential of -0.4V on subsequent addition of 10μM dopamine (DA), 10μM ascorbic acid (AA), 10μM D-Glucose, 10μM L-Glycine, 10μM L-Cysteine, 10μM L-Tyrosine, 10μM L-Tryptophan and 10μM H_2O_2.

References

1 J. R. Lakowicz, *Principle of Fluorescence Spectroscopy* **1999**, Third Edition.