Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B.

Supporting Information

Ordered Assembly of Silver Nanoparticles on Carbon Nitride Sheets and their Applications in Non-enzymatic Sensing of Hydrogen Peroxide and Glucose

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1. Experimental

Graphitic carbon nitride quantum dots (g-CNQDs) were synthesized by MAS-II microwave synthesizer from SINEO Microwave Chemistry Technology (Shanghai, China). Ultrasound was performed by using SINEO UWave-1000 (Shanghai, China) with 28 kHz frequency. UV-Visible spectra were performed by using UV-Visible spectrophotometer of Varian Cary 100 Bio. The quenching and enhancement study was done by spectrofluorimeter from Perkin Elmer (Model is LS 55). Time Correlated Single Photon Counting (TCSPC) spectrometer from Edinburgh (OB920) was used for fluorescence lifetime measurements. FT-IR spectrum was performed by using Perkin Elmer RXI FT-IR spectrophotometer. Powder X-ray Diffraction was taken using Bruker DAVINCI D8 ADVANCE diffractometer equipped with Cu K_α radiation where λ= 0.15406 nm. XPS measurements were done using VG Microtech where monochromatic Mg K_α X-ray was the source. Field-emission scanning electron microscope (FESEM) system (Carl Zeiss, Germany make, Model: ∑igma) was used for taking FESEM images. Transmission electron microscopy (TEM) images were taken from TEM, FEI, Technai G2. Electrochemical measurements were performed with a conventional three electrode system, glassy carbon as a working electrode, platinum wire as a

counter electrode and Ag/AgCl as a reference electrode by using an Electrochemical Workstation (CH Instrument, Model- 1100 A).

2. Fluorescence life time measurement

Fluorescence life time of g-CNQDs in absence and presence of different concentration of Ag^+ ions were evaluated using Time Correlated Single Photon Counting technique. All the decay profiles were recorded in water solvent, 330 nm LED was used to excite the molecule and emission wavelength was kept at 400 nm. Decay curves were fitted by using the following equation:

$$I(t) = \sum_i A_i exp(- t/\tau_i)$$

where I(t) is intensity, assumed as the sum of the individual single exponential decays, A_i is the pre-exponential factor and τ_i is decay time. The all the decay curves were fitted with three exponential functions. Then the average life time was calculated from the following equation

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

3. Fluorescence quenching measurement

Ag^{+} quenches the fluorescence intensity of g-CNQDs in solvent of water. The quenching behavior was studied by Stern Volmer Equation[1]. The Stern Volmer Equation is as follows:

$$F_0/F = 1 + K_{SV}[Q]$$

Where F_0 and F is the fluorescence intensity in absence and presence of quencher, [Q] is the quencher concentration.

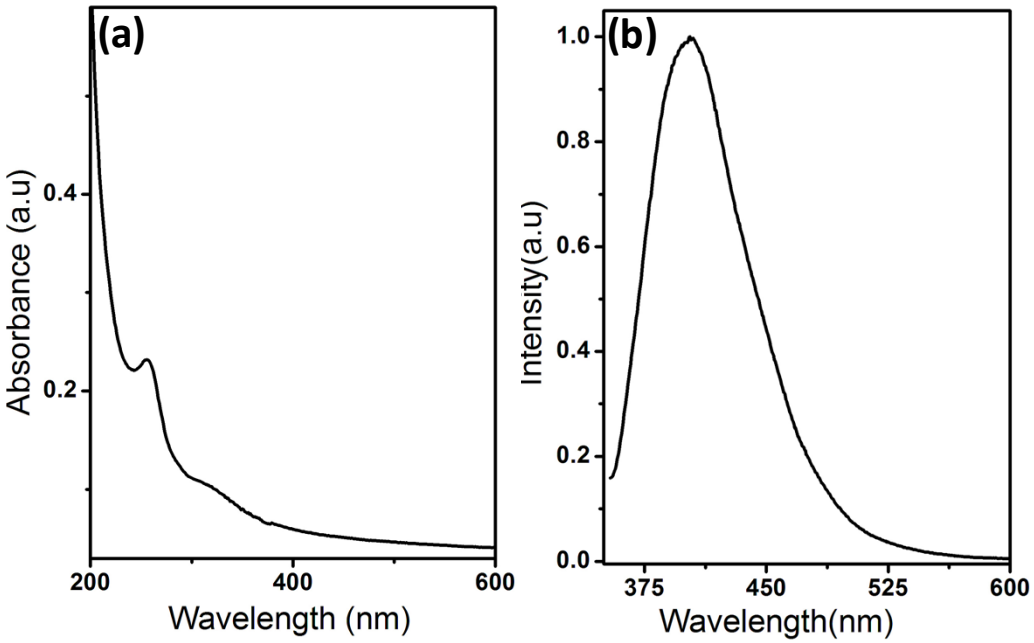

Fig. S1. (a) UV-Visible spectra and (b) Fluorescence spectra of g-CNQDs.

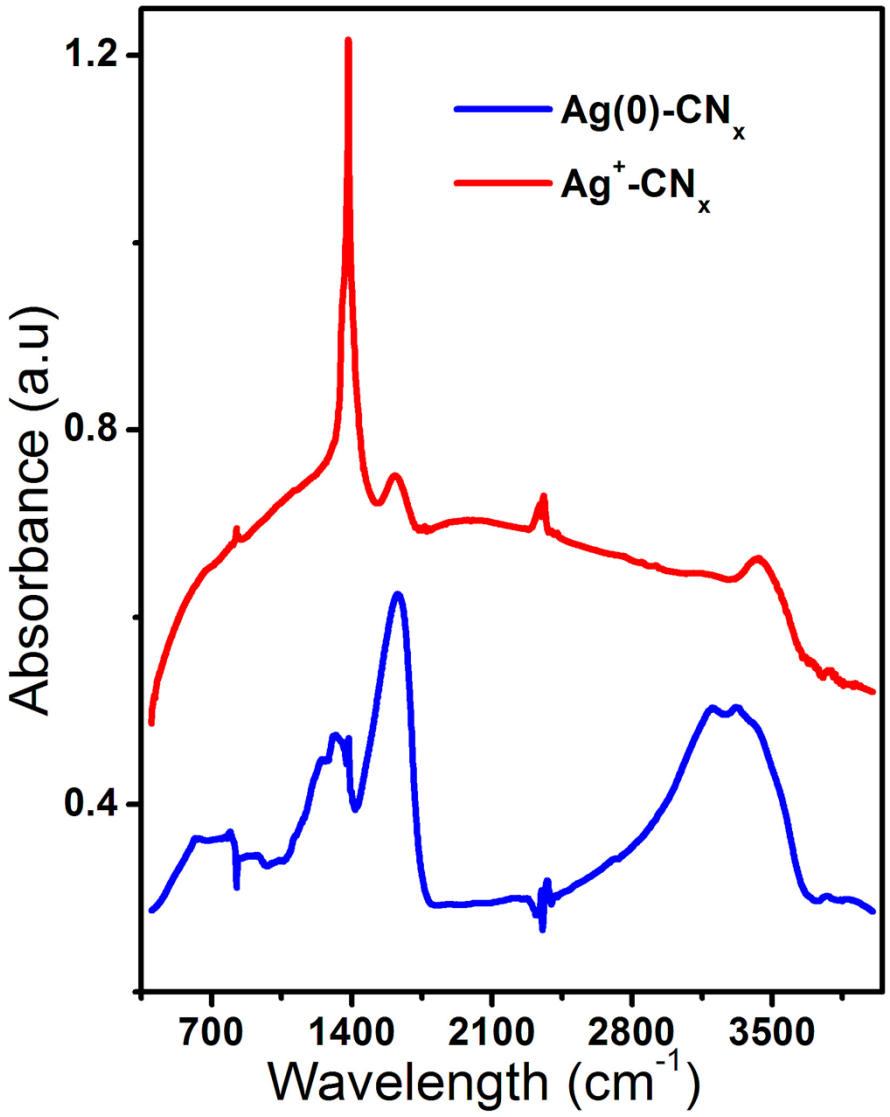

Fig. S2. Comparison FT-IR spectra of Ag^+-CN_x and Ag(0)-CN_x

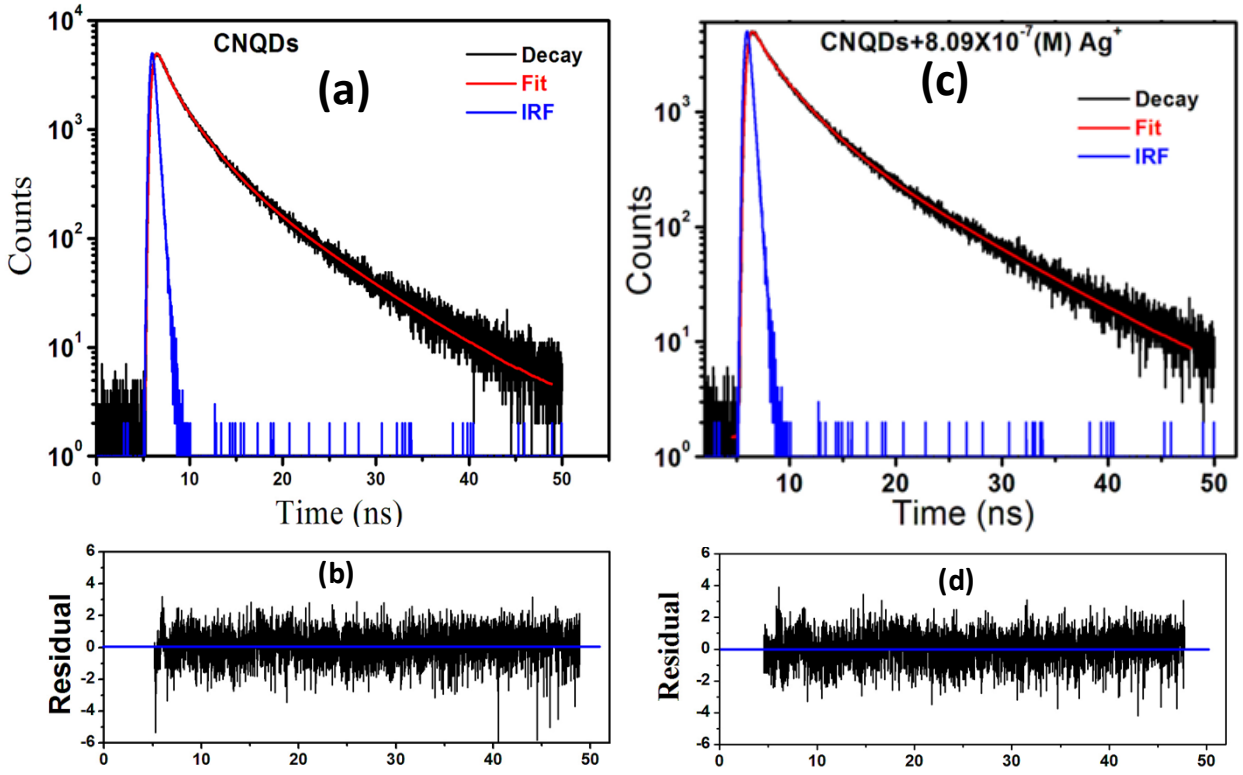

Fig. S3 Fluorescence decay curves, exponential fitting curves and residual plots of g-CNQDs in absence of $AgNO_3$ [(a) and (b)] and in presence of $AgNO_3$ [(c) and (d)].

Table S1. Fluorescence decay time (τ ns) and pre-exponential factor (A) of g-CNQDs in presence of different concentration of Ag^{+} ion in aqueous solution.

	$\tau_1(A_1)$	$\tau_2(A_2)$	$\tau_3(A_3)$	τ_{avg}	χ^2
g-CNQDs	0.6799(0.012)	2.7490(0.011)	7.5992(0.003)	4.280	1.078
g-CNQDs + 1.186 X 10^{-7}(M) Ag^{+}	0.6009(0.011)	2.6654(0.012)	7.4850(0.003)	4.215	1.098
g-CNQDs + 2.34 X 10^{-7}(M) Ag^{+}	0.676(0.010)	2.8906(0.012)	7.8634(0.003)	4.464	1.070
g-CNQDs + 4.58 X 10^{-7}(M) Ag^{+}	0.5643(0.010)	2.8836(0.012)	7.9503(0.003)	4.565	1.122
g-CNQDs + 8.09 X 10^{-7}(M) Ag^{+}	0.5139(0.010)	2.8901(0.012)	8.2359(0.003)	4.748	1.036

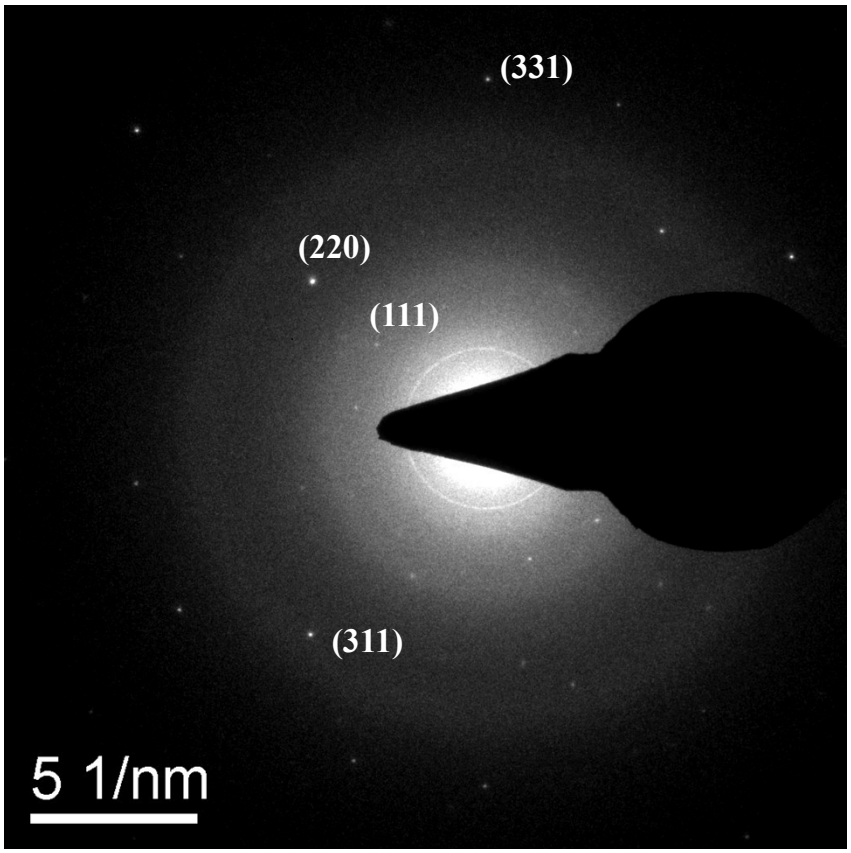

Fig. S4 SAED image of AgNPs taken from Fig. 5(b).

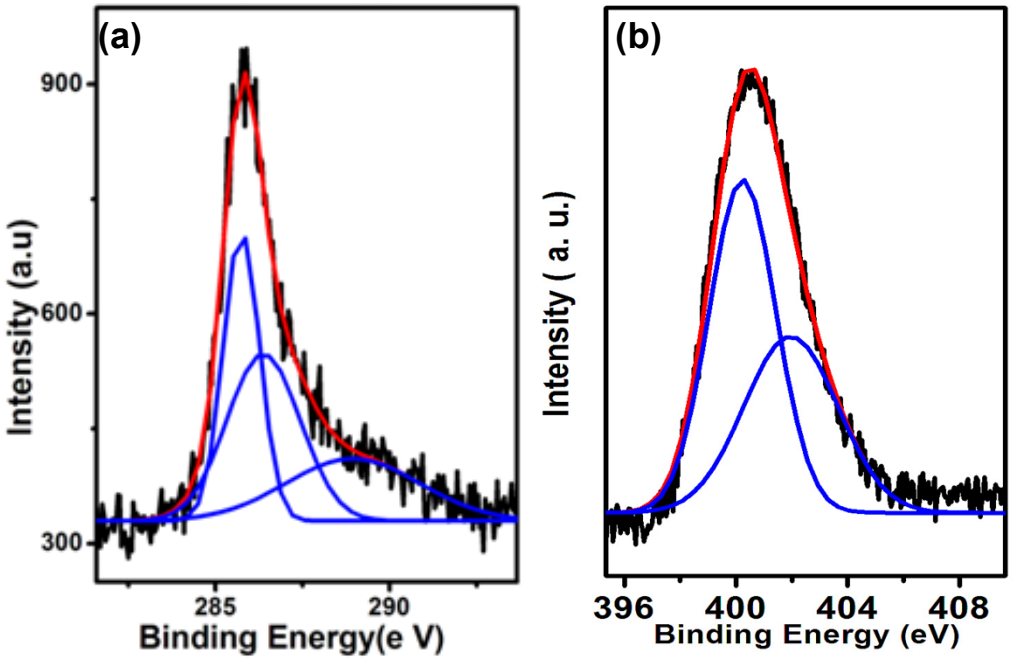

Fig. S5 (a) C1s and (b) N1s XPS spectra of CN_x.

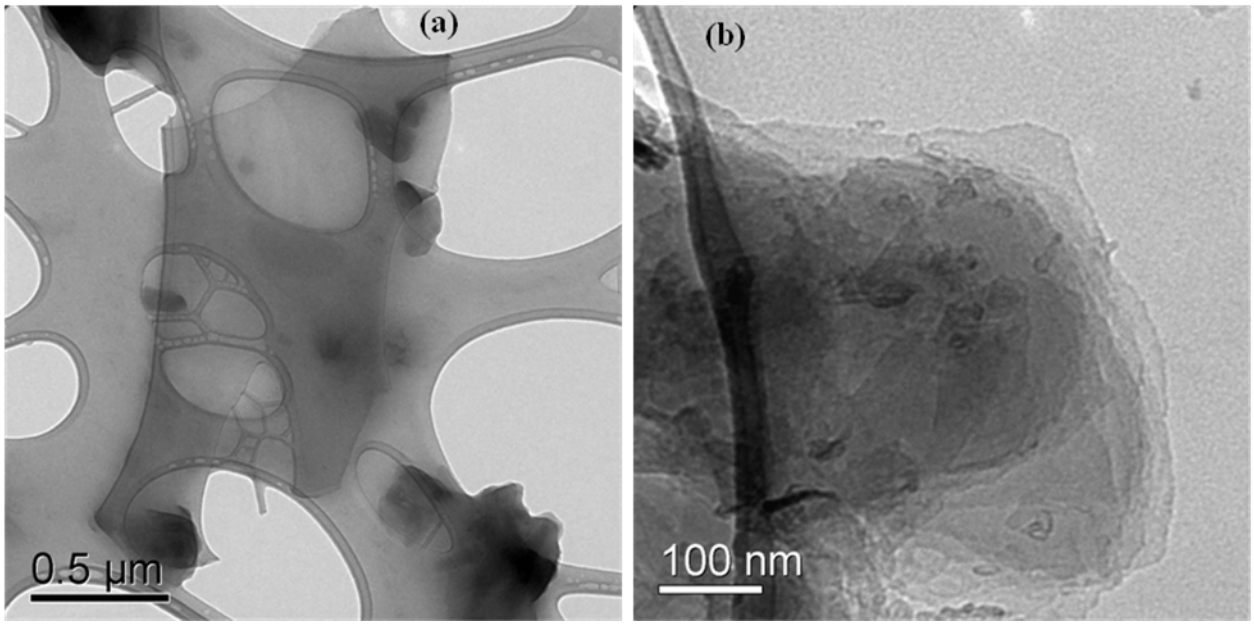

Fig. S6 (a, b) TEM images of CN_x sheets prepared from g-CNQDs.

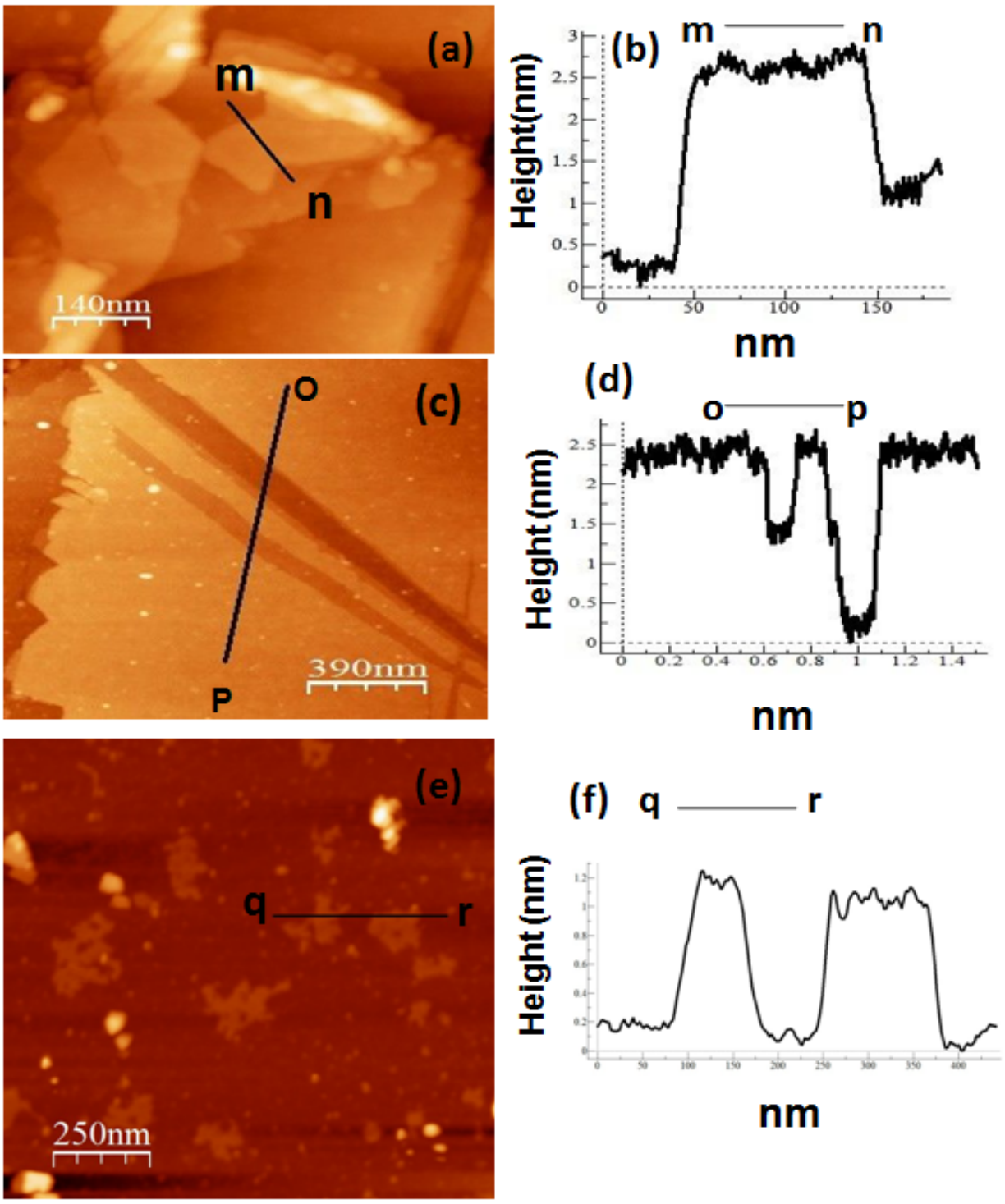

Fig. S7 (a, c, e) AFM images of thin CN_x sheets and (b, d, f) the line profile along the line m-n, o-p and q-r from the image (a), (c) and (e) respectively. The CN_x sheets with thinness from 1nm to 3nm are formed on evaporation of different concentration of g-CNQDs solutions.

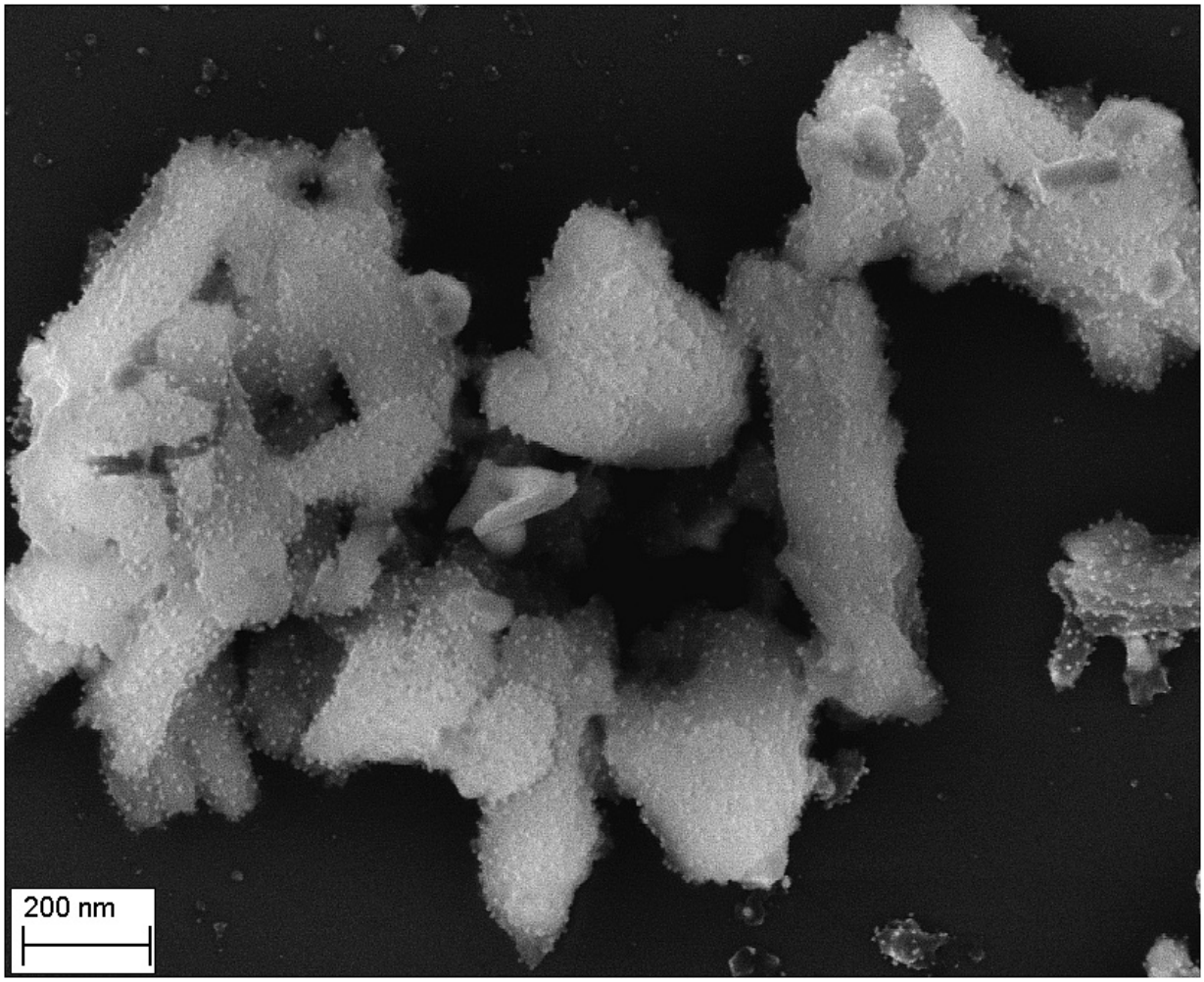

Fig. S8 SEM image of AgNPs assembly on CN_x sheet.

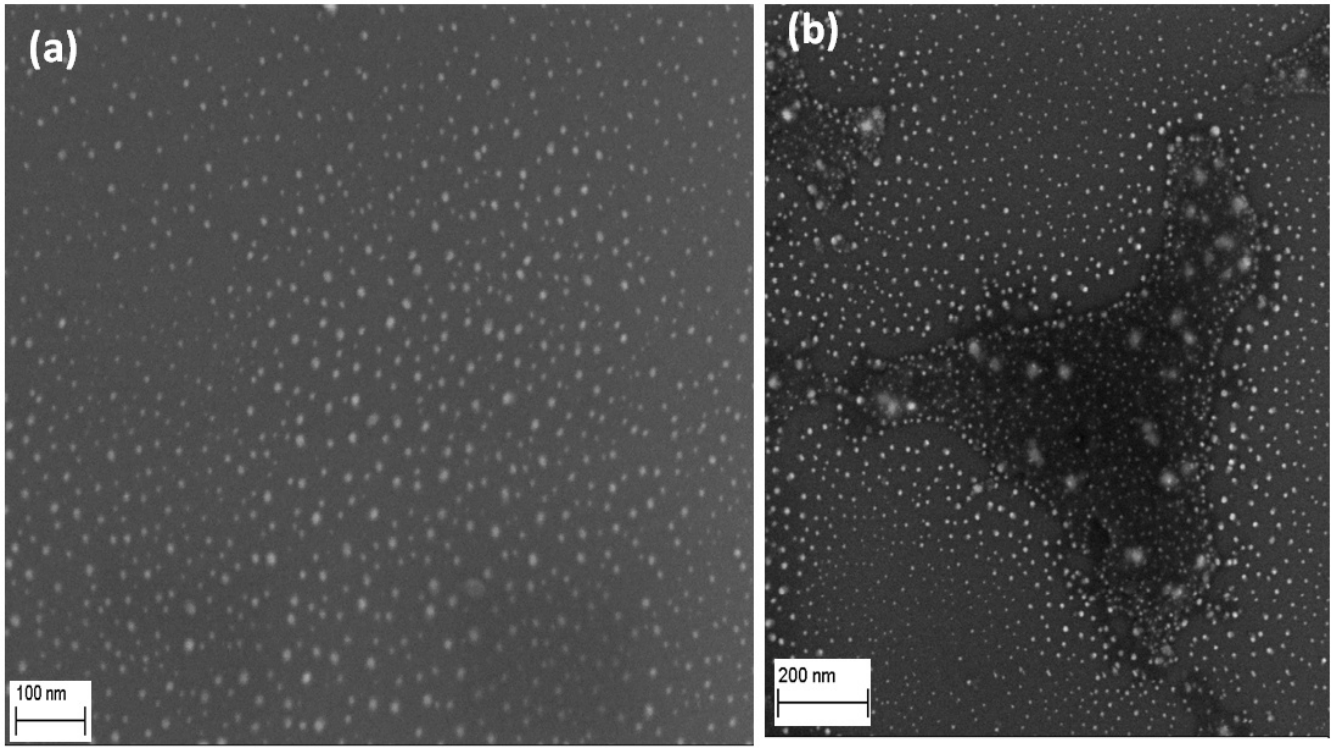

Fig. S9 (a) and (b) SEM images showing ordered assembly of AgNPs on thin CN_x sheets.

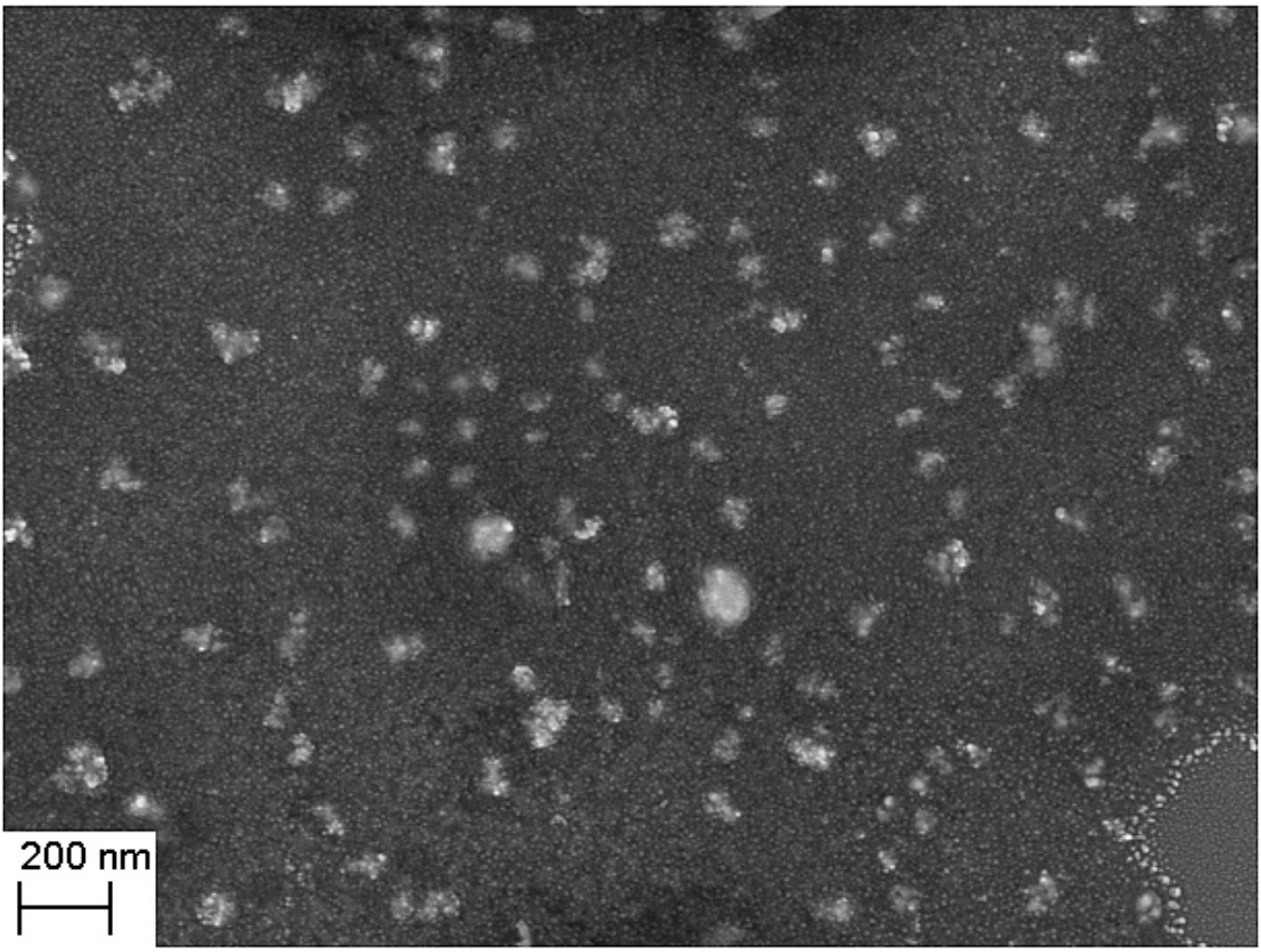

Fig. S10 SEM image of highly ordered 2D assembly AgNPs on CN_x sheet.

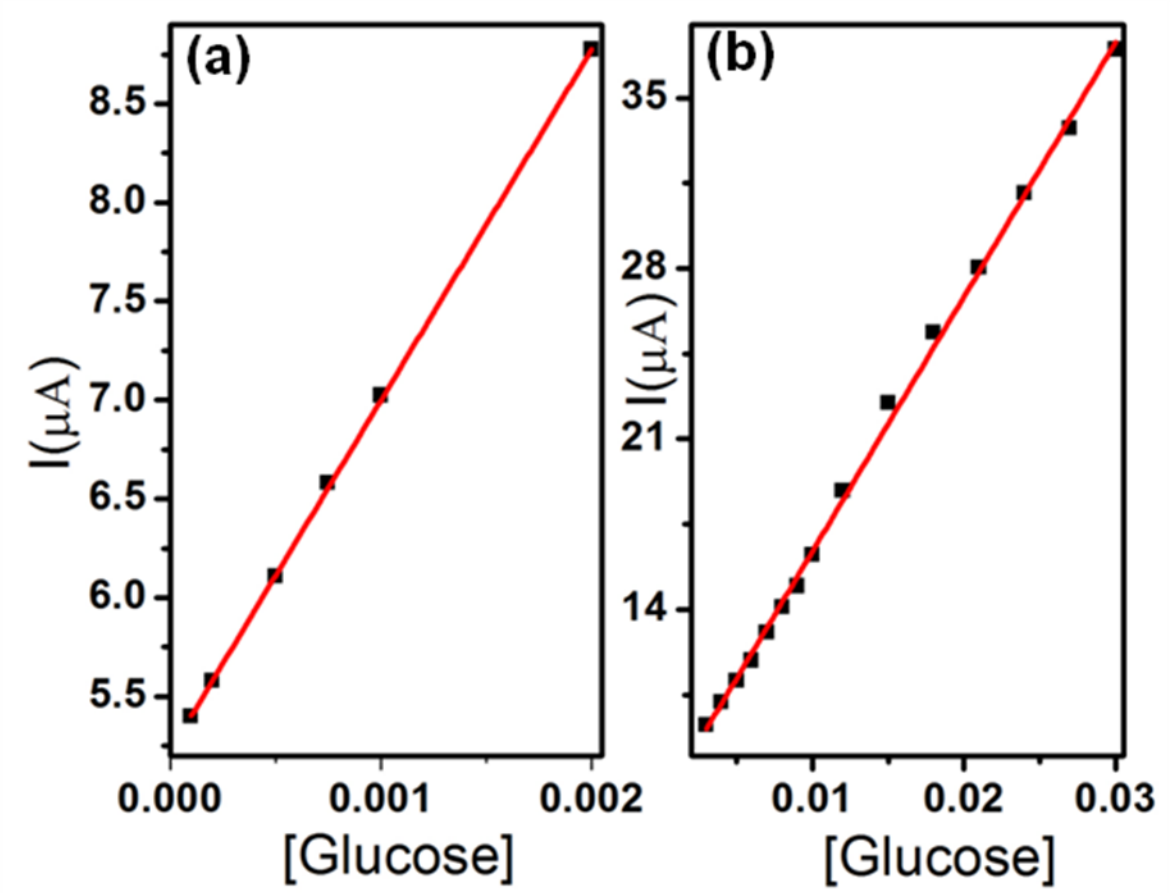

Fig. S11 (a) Calibration curve of current vs. glucose concentration (100 μM - 2 mM) (b) Calibration curve of current vs. glucose concentration (2 mM - 30 mM).

References

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