Electronic Supplementary Material (ESI) for Nanoscale.

Ultrafine and well dispersed silver nanocrystals on 2D nanosheets: synthesis and application as a multifunctional material for electrochemical catalysis and biosensing

*Tao Gao,[a] Dawei Yang,[a] Limin Ning,[a] Lin Lei,[a] Zonghuang Ye,[a] Genxi Li [a, b, *]*

[a]State Key Laboratory of Pharmaceutical Biotechnology, Department of Biochemistry, Nanjing University, Nanjing 210093, China

[b]Laboratory of Biosensing Technology, School of Life Sciences, Shanghai University, Shanghai 200444, P R China

*Address correspondence to genxili@nju.edu.cn

[*]Corresponding author at Department of Biochemistry, Nanjing University, Nanjing 210093, China. Tel: +86 25 83593596. Fax: +86 25 83592510.

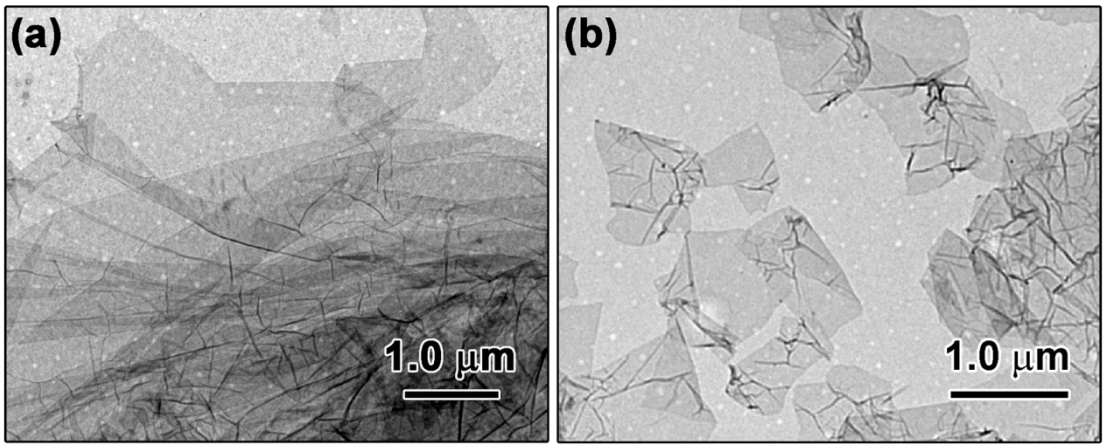

Fig. S1. TEM images of GO sheets before (a) and after (b) the treatment of ultrasonication and centrifugation filtration.

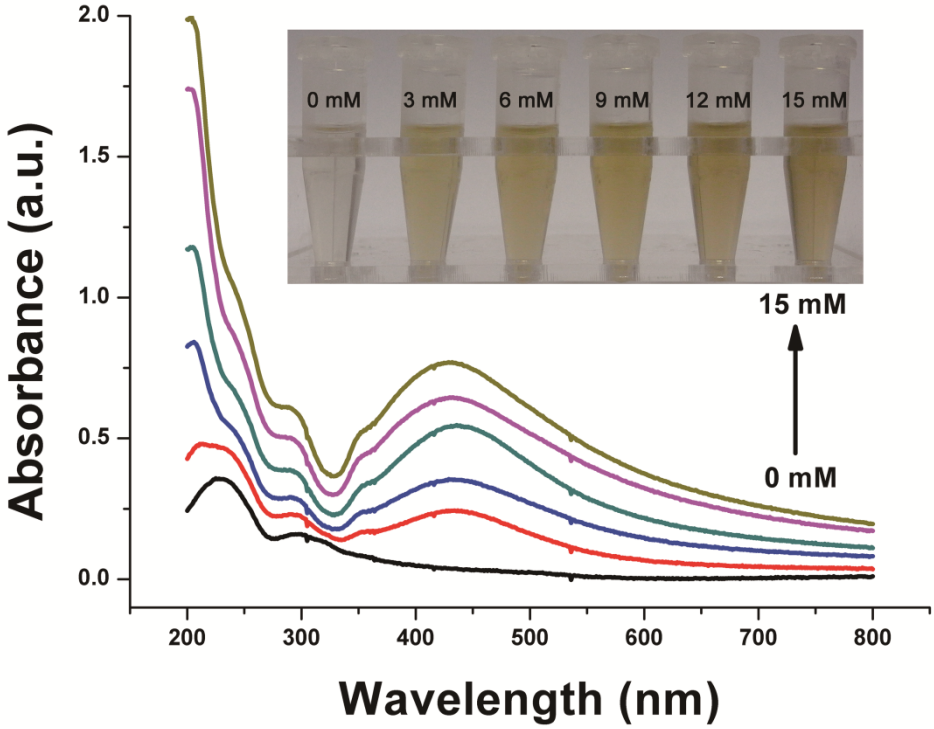

Fig. S2. The UV-vis spectra of the reaction solutions contain different concentrations of $AgNO_3$ (0, 3, 6, 9, 12 and 15 mM). The insert photograph shows the corresponding appearance of these reaction solutions.

Electrochemical properties of GO-Ag hybrids

Electrochemical properties of GO-Ag hybrids were studied by cyclic voltammetry (CV) and electrochemical impedance spectra (EIS). The electrolyte was 5 mM $[Fe(CN)_6]^{3-/4-}$ containing 0.1 M KCl. As shown in **Fig. S3**, the anodic and cathodic peak values for GO are relatively low, indicating large interfacial electron transfer (ET) resistance. This is because GO flakes are typically insulating with an energy gap in the electron density of states.[1] However, the peak values for GO-Ag hybrids have been increased much, almost the same as bare electrode. This reveals the coreduction strategy could significantly reduce GO and increase the conductivity of the hybrids. EIS technique has been further used to demonstrate the ET ability of GO-Ag hybrids. The semicircle portion at higher frequencies relating to the electron transfer limited process and the linear part at lower frequencies corresponding to diffusion in the spectra. So, the increase of the semicircle diameter may reflect the increase in the interfacial ET resistance. A large semicircle portion shows the high ET resistance of GO. EISs of the GC (black curve) and GO-Ag/GC electrodes (red curve) are almost a straight line, indicating a very low ET resistance. This is in accord with the results of CVs.

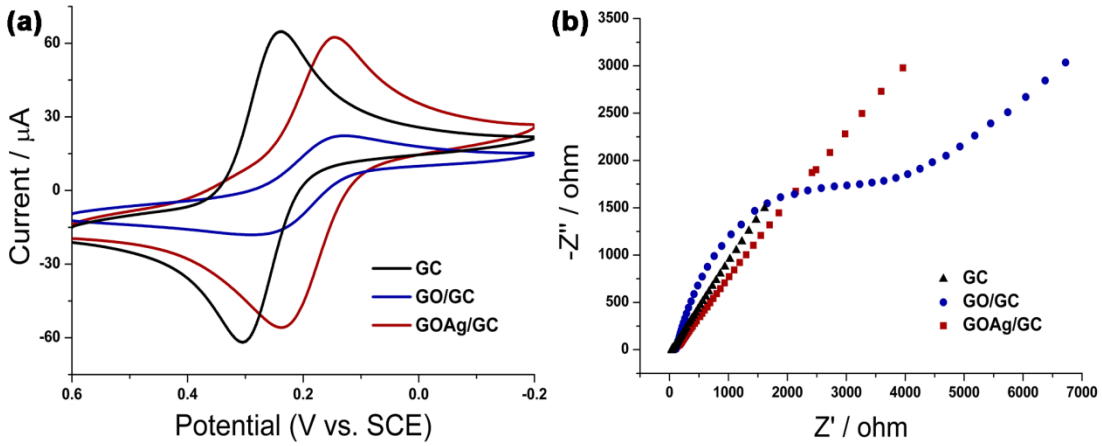

Fig. S3. (a) Cyclic voltammograms of GC (black curve), GO/GC (blue curve) and GO-Ag/GC (red curve) electrodes. (b) Electrochemical impedance spectra of GC (black curve), GO/GC (blue curve) and GO-Ag/GC (red curve) electrodes. The electrolyte was 5 mM $[Fe(CN)_6]^{3-/4-}$ containing 0.1 M KCl.

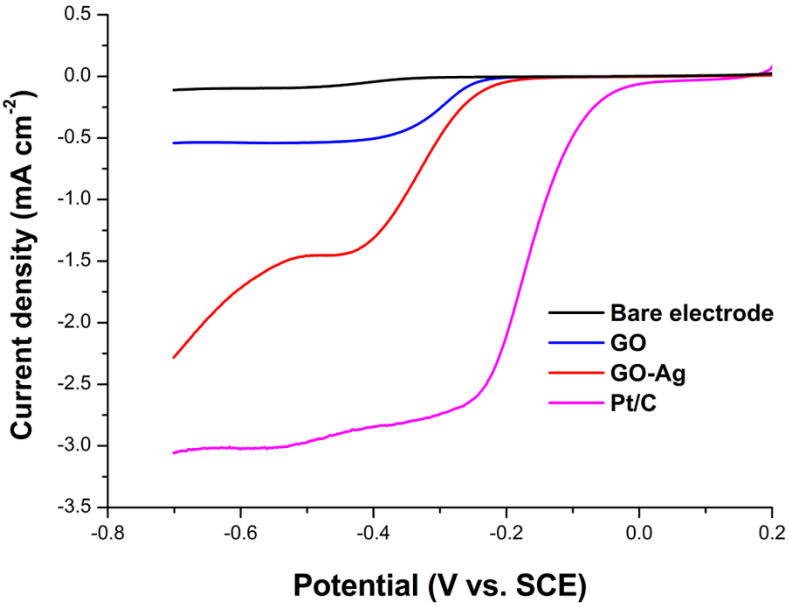

Fig. S4. Linear sweep voltammetry curves of GO, GO-Ag and Pt/C modified on rotating disk electrodes in O_2 saturated 0.1 M KOH solution with a sweep rate of 50 mV s^{-1} at a rotation rates of 1600 rpm.

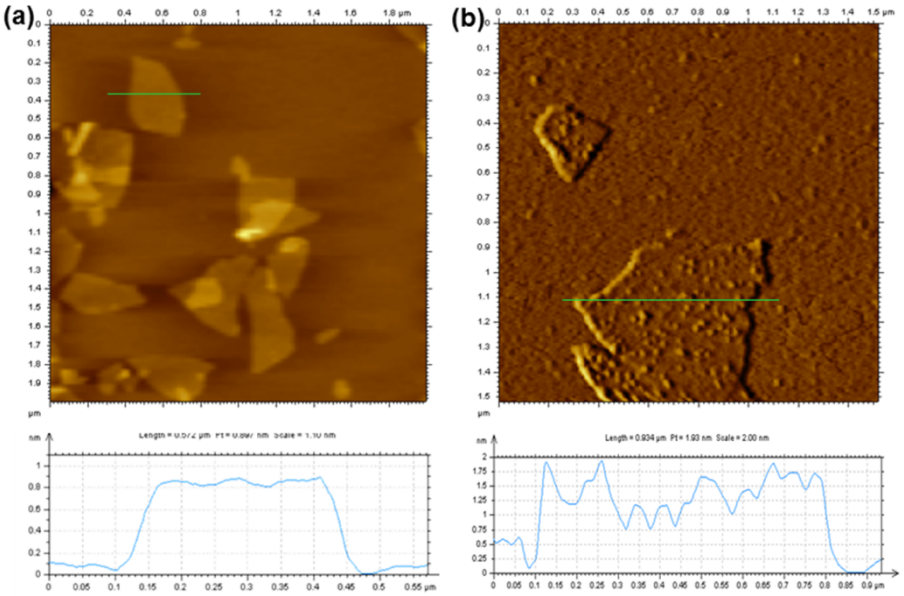

Fig. S5. AFM images of (a) GO nanosheets and (b) GO-Ag nanohybrids.

Table S1. A comparison of the quality of GO-Ag hybrids made from different synthetic routes

	Synthetic routes	Particle size (nm)[a)]	Surface coverage density (μm^{-2})[b)]	Number of stacked layers[c)]
Ex suit	LBL electrostatic self-assembly technique[2]	80,70±40	150	many
	$\pi-\pi$ stacking via bovine serum albumin[3]	13±10	800	many
In suit	Chemical reduction by $NaBH_4$[4-6]	10±2; 6±3; 10±5, 50	2400; 11898; 13100	>2; many; many
	Chemical reduction by $NaBH_4$ (DNA templated)[7]	~12	1150	>3
	Chemical reduction by glucose[8]	50±19	36	1~2
	Chemical reduction by hydrazine[9]	25±10	325	many
	Chemical reduction by hydroquinone[10]	80	2	many
	Chemical reduction by bioreductants[11]	5~10, 100~150	88, 44	1~3
	Chemical reduction in aqueous KOH[12]	3~12	1100	many
	Chemical reduction based on silver mirror reaction[13]	10±7	1250	many
	Hydrothermal method in hydrazine[14]	40-70, ~50	100	many
	Hydrothermal method on solid surface[15]	<200, 2.7±0.8	1450	1~2
	Hydrothermal method in strong alkaline condition[16]	40, 5±2.5, 40±10	1,328,100	1~3
	One-time calcination[17]	>35, 5±5, 10±7	2500	>4
	Solid surface electrodeposition[18]	20.35±5.18	168	1~2
	Surface reduction by functionalized dopamine[19]	7.71±1.34	600	2~4
	Microwave-assisted chemical reduction by DMF[20]	<10	12	many
	Facial-induced coreduction by hydroquinone (This work)	2.9±1.4	5250	1~2

a) Size and size distribution of the AgNCs were mainly obtained from the references, and others were calculated from TEM images.

b) Surface coverage density shows the numbers of nanoparticles per square micrometer, which were calculated from TEM images.

c) The number of stacked layers reveals the dispersibility of the synthesized GO-based hybrids.

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