Supporting Information Available

Chemical amination of graphene oxides and their extraordinary properties in the lead ions detection

Bin Wang, ¹ Bin Luo, ¹ Minghui Liang, ¹ Ali Wang, ¹ Jie Wang, ¹ Yan Fang, ¹ Yanhong Chang²*, Linjie Zhi ¹*

¹National Center for Nanoscience and Technology, Beiyitiao 11, Zhongguancun, Beijing 100190, China. Tel. / fax: +86 10 82545578. E-mail: <u>zhilj@nanoctr.cn</u>

²Department of Environmental Engineering, University of Science and Technology of Beijing, Beijing 100083, China. E-mail: <u>yhchang0512@yahoo.com.cn</u>

Experimental section

Sample characterization

Fourier transform infrared spectroscopy (FTIR) was carried out using a Spectrum One B-type spectrometer with KBr, recorded in the 400-4500cm-1 region. X-ray diffraction (XRD) patterns were obtained on a Rigaku D/max-2005B2+/PCX diffractometer operating at 40KV, 200mA, using Cu Kα radiation. Atomic force microscopy (AFM) measurements were performed using a NanoMan instrument. Transmittance electron microscopy (TEM) images were obtained on Tecnai G2 20 ST. Element analysis data was obtained on Flash EA 1112. The X-ray photoelectron spectroscopy (XPS) data were taken on an AXIS Ultra instrument from Kratos Analytical. Raman spectra were measured

with a Renishaw inVia plus. The Zeta potential was measured using a Zeta potential analyzer (Zetasizer Nano ZS, Malvern Instruments).

Preparation of graphene

All reagents used were of analytical reagent degree. After washing thoroughly, graphite oxide (GO) solution was filtered. The final filter cake was dried at 60° C in air and powdered in an agate mortar successively. The followed preparation process of graphene was performed in a sealing vertical quartz tube system. GO powder was placed in a container on the top of the quartz tube. Firstly, the quartz tube in the furnace was heated to 900°C and the inert atmosphere was kept by the Ar flow. Then GO powder was blown up and carried through the quartz tube by increasing the velocity of Ar flow. The obtained graphene was carried away by the flow and accumulated in ethanol. Finally, the graphene solution was well dispersed by the assistance of strong ultrasonic treatment for 1 hour and the sediment yield after standing for 1 day was removed. The obtained graphene solution was characterized and applied in Pb²⁺ detection. The detection process was similar to the AGO detection method mentioned in the main text.



Fig. S1 TEM image of graphene obtained from the megathermal expansion of graphite oxide powder.



Fig. S2 DPV curves recorded using a graphene modified electrode in different Pb^{2+} concentrations: from top to bottom, 0.1nM, 0.01nM, 0.001M. It is apparently to notice that the detection limit is 0.01nM.



Fig. S3 TGA curves of GO and AGO30, with a heating rate of 10°C/min in nitrogen. Weight loss ratio

about 14% demonstrates the less oxygen containing groups in AGO30 than GO.



Fig. S4 DPV curves recorded using AGO30 modified electrode in 10μ M Pb²⁺ by adding different Hg²⁺ concentrations.



Fig. S5 DPV curves recorded using an Nafion modified electrode in a solution containing a mixture of equal molar amount of Cu^{2+} , Pb^{2+} , Cd^{2+} and Zn^{2+} (100nM and 10nM).



Fig. S6 The analysis of tap water collected from the laboratory. The final tap water solution compromises 50μ M Hg²⁺ and HCl (pH 3.5). The preconcentration time is 5 minutes. The deposition potential of -1.2 V is applied for 1 minute. Compared with the calibration curve, the Pb²⁺ content in the tap water is about 2pM. Taking the influence of other ions in the water into consideration, the Pb²⁺ content in the tap water must be higher than 2pM.

XPS concentration	C1s (%)					N1s (%)	
	C=C	C-N	C-0	C=O	C(O)O	C(O)N	-NH ₂
GO	51.3	0	36.6	6.1	5.9	0	0
AGO30	55.5	25	9.3	6.5	3.7	52	48
AGO80	54.2	34.4	3.8	5.5	2.0	73	27

Table S1. The contents of functional groups of C1s and N1s in the samples