Supporting information

Ultrasensitive detection of arsenic in water using laser-scribed graphenebased electrodes

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Figure S1. X-ray photoelectron spectra (XPS) of Fe_3O_4/LSG with the (a) survey spectra & deconvoluted short scan in the (b) O 1s region, (c) C 1s region



Figure S2. Cyclic voltammograms of LSG & Fe₃O₄/LSG electrodes (a, b) bare LSG electrodes 2 and 3, (c, d) 0.01M Fe₃O₄/LSG electrodes 2 and 3, (e) 0.05M Fe₃O₄/LSG electrode 2, and (f) 0.1M Fe₃O₄/LSG electrode 2. All measurements were performed relative to external Ag/AgCl (3M KCl) reference electrode for 5 mM K₄(FeCN)₆ in 0.1M acetate buffer solution (ABS) at the scan rate of 50 mV/s.



Figure S3: Optimization of deposition potential & deposition time using square wave anodic stripping voltammetry (SWASV) response of Fe_3O_4/LSG electrodes in arsenic in 0.1M Acetate Buffer Solution (ABS) at (a) Various deposition potentials, (b) Various deposition times. SWASV conditions: conditioning potential: 0.6 V, conditioning time: 120 s, deposition potential: -0.4 V, deposition time: 120 s, amplitude: 30 mV, frequency: 30 Hz & step increment: 4 mV. All measurements were performed relative to an external Ag/AgCl (3M KCl) electrode.



Figure S4 : Performance comparison of 4 different Fe_3O_4/LSG electrodes using square wave anodic stripping voltammetry (SWASV) response in no arsenic, 1 ppb arsenic solution & a real world sample in 0.1M Acetate Buffer Solution (ABS) (a) Electrode 1, (b) Electrode 2, (c) Electrode 3 & (d) Electrode 4. SWASV conditions: conditioning potential: 0.6 V, conditioning time: 120 s, deposition potential: -0.4 V, deposition time: 120 s, amplitude: 30 mV, frequency: 30 Hz & step increment: 4 mV. All measurements were performed relative to an external Ag/AgCl (3M KCl) electrode.

Electrode	Metal ion	Detection limit	Method	Ref.
GCE/rGO/red mud	As	0.07 ppb	SWASV	3
GCE/Ag/GO	As	0.24 nM	ASV	2
GCE/Au/Fe ₃ O ₄	As	0.00097 ppb	SWASV	44
GCE/Pt/GR	As	1.1 nM	SWASV	8
GCE/Au/rGO	As	0.2 ppb	ASCV	45
GCE/rGO/ Fe ₃ O ₄	As	1.19 ppb	SWASV	1
rGO/Fe ₃ O ₄	Cr	**	CV	46
SPE-Au	As	2.5 ppb	SWASV	48
SPE-C/Au-nanostar	As, Cd, Se	0.8 ppb	SWASV	47
SPE/rGO/Fe ₃ O ₄	As	0.1 ppb	DPASV	34
SPE-GR/Bi/Nafion	Zn, Cd, Pb	0.09, 0.06, 0.08 ppt	SWASV	49
LIG/Ag	Cd, Pb, Cu	0.1 ppb	SWASV	30
LIG/Au	As (in soil)	0.18 ppb	SWASV	31
LIG fiber/Bi	Cd, Pb	0.4 ppb	SWASV	29
LIG/Bi-Sn	Pb, Cd	1.6, 0.9 ppb	SWASV	9
LIG/Cu	Hg	1.84 ppb	SWASV	32
Fe ₃ O ₄ /LSG	As	0.0636 ppb	SWASV	Present study

Table 1. Comparison of sensing parameters for various graphene electrodes for different heavy

 metal detection

[ASCV-Anodic stripping cyclic voltammetry, DPSV-Differential pulse stripping voltammetry, DPASV-Differential pulse anodic stripping voltammetry]

Electrode	Current (As=0 ppb)	Current (As=1 ppb)	Current (real sample)	As in sample
E1	105.19 µA	168.29 μA	314 µA	60.96 ppb
E2	99.55 μA	166.33 μA	309.01 µA	59.69 ppb
E3	102.95 μA	167.69 μA	317.50 µA	62.68 ppb
E4	94.99 μA	160.36 µA	299.81 µA	58.34 ppb
ICP-OES	-	-	-	60 ppb

 Table 2. Detection results for real sample