

SUPPLEMENTARY INFORMATION

Enhancing the Sensitivity of Point-of-Use Electrochemical Microfluidic Sensors by Ion Concentration Polarisation - A Case Study on Arsenic

Vidhya Subramanian^{a,b}, Lee Sangjun^c, Sanjoy Jena^d, Sourav Kanti Jana^a, Debdutta
Ray^d, Sung Jae Kim^c and Thalappil Pradeep^{*a}

^aDST Unit on Nanoscience and Thematic Unit of Excellence (TUE), Department of Chemistry, Indian Institute of Technology, Madras, Chennai 600 036, India

^bDepartment of Biotechnology, Indian Institute of Technology, Madras, Chennai 600 036, India

^cDepartment of Electrical and Computer Engineering, Seoul National University, Seoul 08826, Korea

^dDepartment of Electrical Engineering, Indian Institute of Technology, Madras, Chennai 600 036, India

E-mail: pradeep@iitm.ac.in

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S-1. Supplementary Information 1

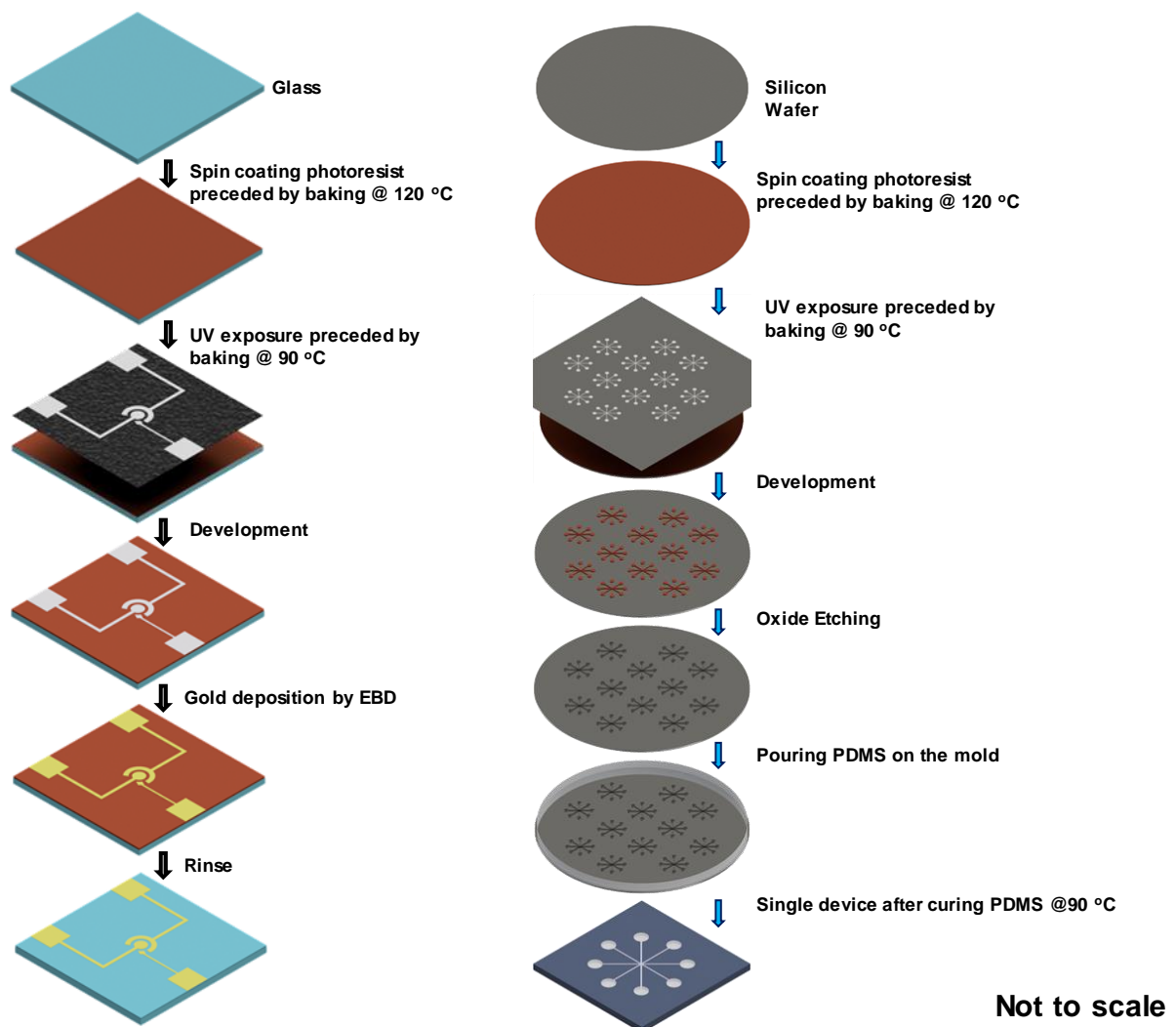


Figure S1. Schematic for the fabrication of electrodes (left) and microfluidic device (right).

S-2. Supplementary Information 2

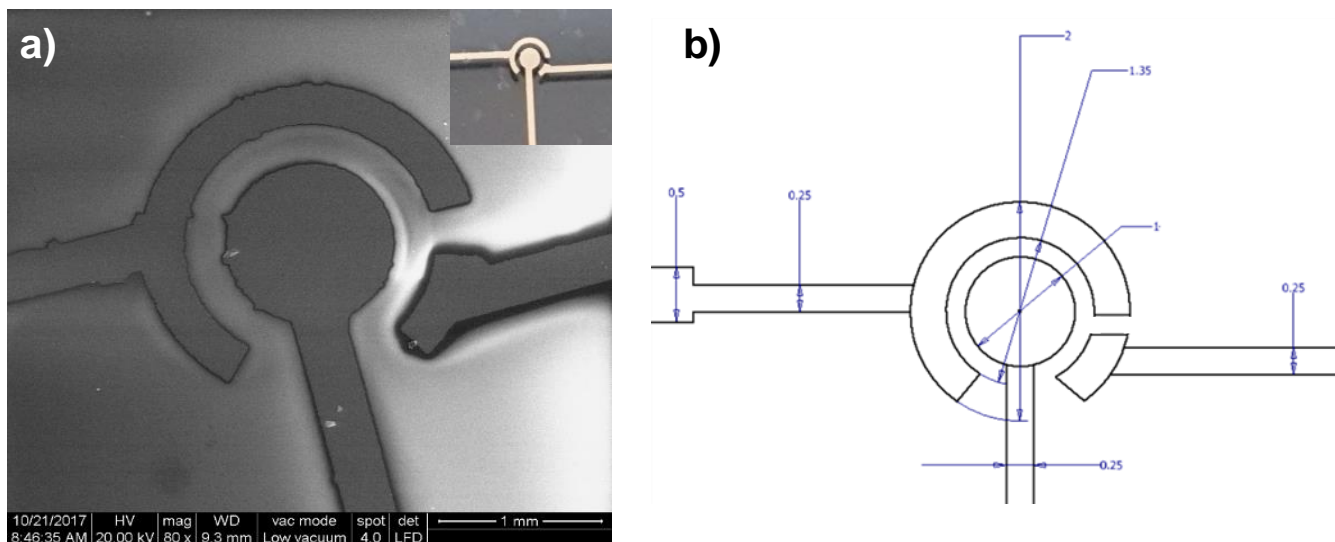


Figure S2. a) SEM image of the electrodes and inset shows its optical image and

b) Schematic of the electrode with dimensions. All dimensions are in mm.

S-3. Supplementary Information 3

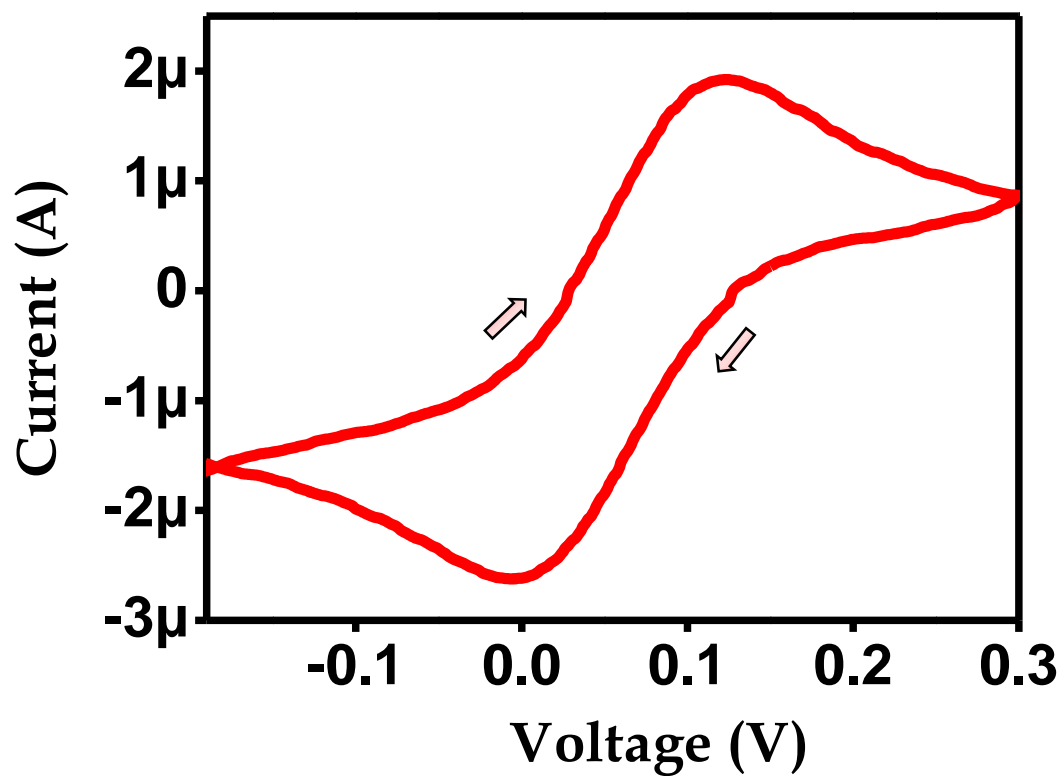


Figure S3. Cyclic voltammetry of 2 mM ferro/ferricyanide complex using the fabricated Au electrode.

Supplementary Information – S -4

Calculations for volume in microchannel and microfluidic device

Microchannel height, width and length are 100 μm , 100 μm and 1 cm respectively.

Volume of a cuboid / 1 microchannel = (l x b x h)

Volume of radial (8) microchannels = $8(0.1 \times 0.1 \times 10) \text{ mm}^3$

$$= 0.8 \text{ mm}^3 = 8 \mu\text{L}$$

The outlet of each channel has a radius of 1 mm and height 1 mm. Considering it as a cylinder,

Volume of a cylinder / 1 outlet = $\pi r^2 h$

Volume of 8 outlets = $8 (3.14 \times 1 \times 1) \text{ mm}^3$

$$= 25.12 \text{ mm}^3 = 25.12 \mu\text{L}$$

The inlet has a radius of 1 mm and is connected to a 10 μL pipette containing $\sim 5 \mu\text{L}$ solution to provide electrical connection.

The electrodes are placed inside 2 layers of PDMS, one with radius of 1.5 mm and the other with radius of 1 mm, both are of 250 μm height.

Volume of solution above the electrode = $(3.14 \times 1.5^2 \times 0.25) + (3.14 \times 1^2 \times 0.25)$

$$= 2.6 \text{ mm}^3 = 2.6 \mu\text{L}$$

Total volume of sample in radial microchannels = 8 μL

Total volume of sample in device = $8 + 25.12 + 5 + 2.6 \mu\text{L}$

$$= 40.72 \mu\text{L}$$

Supplementary Information

Concentration (ppb)	Current (μA)			
	Voltage (V) Time (s)	30	50	100
5	60	$3.49 \cdot 10^{-3}$	0.02	0.10
	150	$5.18 \cdot 10^{-3}$	0.12	0.49
	300	$6.02 \cdot 10^{-2}$	0.97	1.82
10	60	0.12	0.43	0.55
	150	0.45	1.41	1.11
	300	1.33	1.63	3.11
25	60	0.79	0.86	1.25
	150	0.81	2.05	3.18
	300	1.81	3.09	5.08

Table 1. Tabular column representing the data of electrochemical characterization of As^{3+} for different concentrations, potentials and durations.

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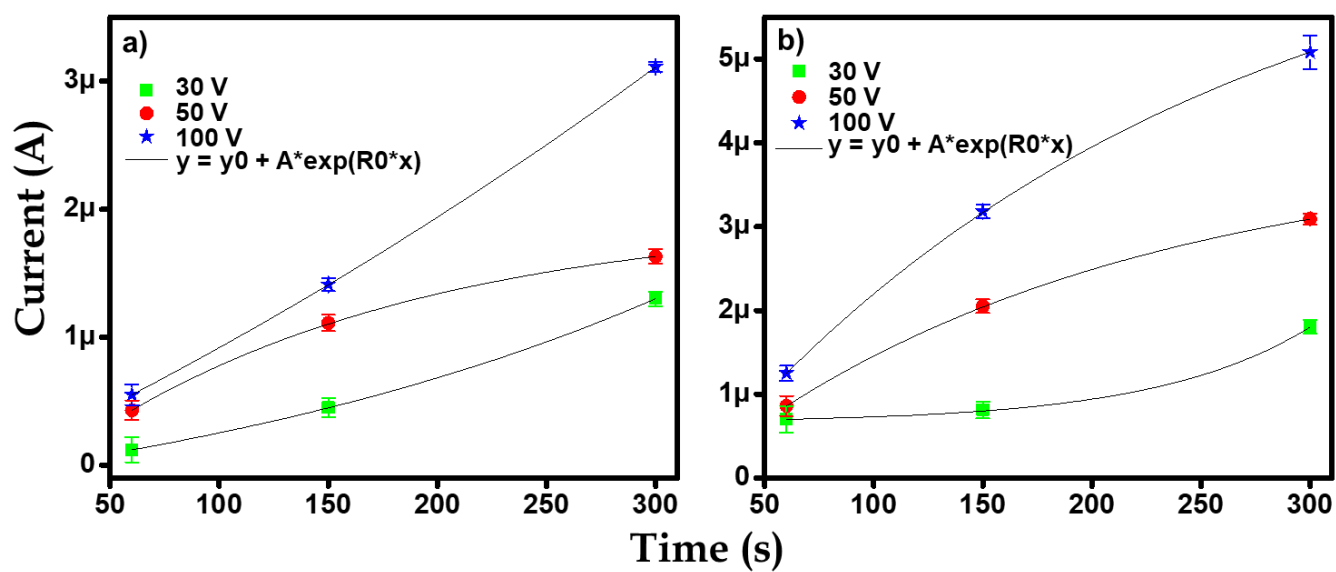


Figure S5. Variation of the voltammetric signal at the peak voltage (0.21 V) for a) 10 ppb and b) 25 ppb of As^{3+} with time at different ICP voltages. The data are fitted with straight lines.

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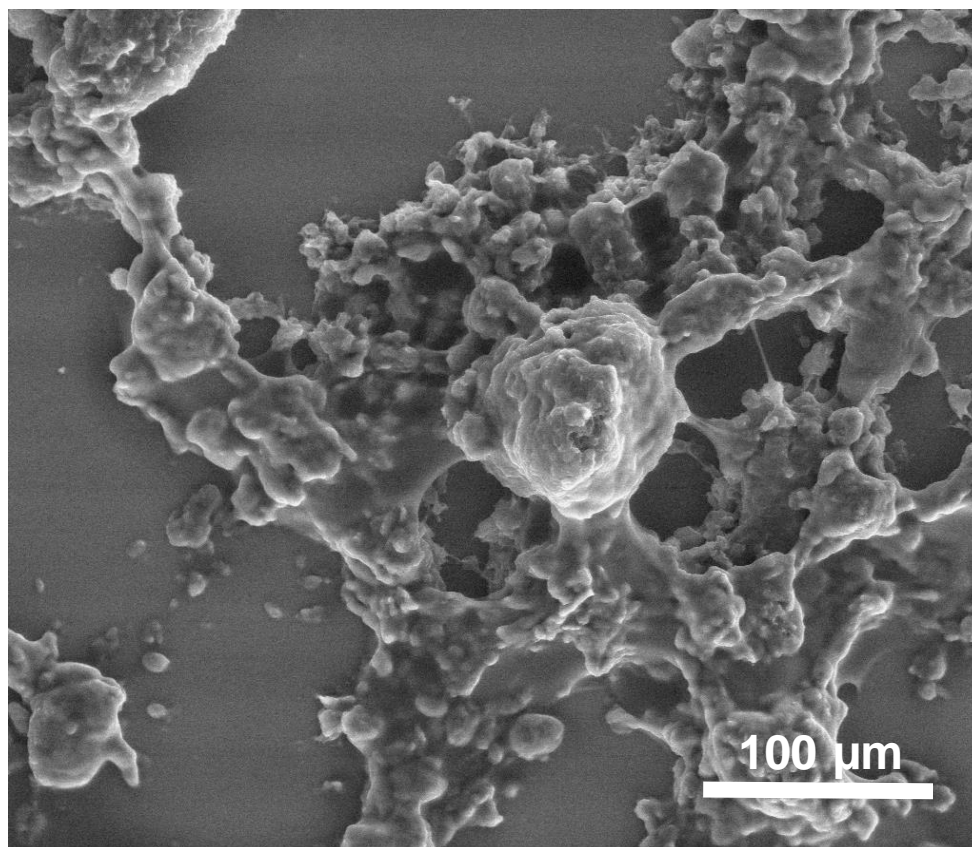


Figure S6. SEM image of Mn²⁺ deposition on gold electrode after ICP at 30 V for 150 s.

Supplementary Information

Electrode	Electrolyte	Technique/ Deposition time (s)	Experimental LOD (ppb)	Ref
ZrO ₂ /Nafion/Au electrode	PBS	CV	5	1
Au/Fe ₃ O ₄ modified screen printed carbon electrode	0.1 M HAc- NaAc	SWASV/120 s	0.1	2
NH ₂ -GO modified Au μelectrode	PBS	SWASV/ 150 s	4.113	3
AuNPs/CeO ₂ -ZrO ₂ /GCE	0.1 M HAc- NaAc	SWASV/ 150 s	0.5	4
FePt NP coated Si (100) substrate	PBS	SWASV/ 60 s	0.8	5
Au NPs on Boron Doped Diamond electrode	Phosphate buffer	ASV/ 300 s	1	6
Glutathione, dithiothreitol and <i>N</i> -acetyl-L-cysteine on gold electrode	HCl	LSV /150 s	0.5	7
Tin oxide nano needles on graphite pencil electrode	Water	CV	10	8
Fe-Chitosan coated Carbon electrode	Mining wastewater	SWASV/ 180 s	1.12	9
Au electrode	H ₂ SO ₄ / Water	Microfluidics + LSV	1 / 7	This work

Table 2. Comparison of performance parameters between different studies for the detection of As³⁺

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