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Electronic Supplementary Information

A novel laminated polycaprolactone/paper/silver electrode for lead (II) detection

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1 Materials and instruments

Silver conductive ink (AG–755) was purchased from Conductive Compounds (Hudson, NH, USA). Polycaprolactone (PCL) pellets (Capa™ 6800) were supplied by Perstorp (Warrington, Cheshire, UK). Lead (II) nitrate, $Pb(NO_3)_2$, was bought from Sigma Aldrich (St. Louis, MO, USA). All other chemicals used in this work were of analytical grade. Whatman chromatography paper (Grade 1 CHR) was bought from GE Healthcare Life Sciences (Little Chalfont, Buckinghamshire, UK). Disposable antistatic microspatulas (length 14 cm, color opaque) were bought from VWR International, LLC (Radnor, PA, USA). The buffer solution used for preparing standard solutions of Pb (II) is acetate buffer (0.2 M, pH 4.4) according to the similar references.[1,2] The pH value of the acetate buffer was selected to be 4.4 according to similar studies.[1,2] For the specificity study of the developed electrode, several commonly occurring inorganic cations (Fe^{3+}, K^+, Na^+, Ca^{2+}, Mg^{2+}) have been checked. And the salt for preparing such solutions were all in chloride form ($FeCl_3.6H_2O$, KCl, NaCl, $CaCl_2$, $MgCl_2.6H_2O$). Aqueous solutions used throughout were prepared with ultrapure water (＞18.2 MΩ cm resistivity) obtained from a Milli-Q water purification system.

All patterning work was accomplished using a 50 W CO_2 laser cutter (VLS 3.50, Universal Laser Systems, Scottsdale, AZ, USA). The electrochemical measurements were carried out on a CHI 123B Electrochemical Workstation (CH Instruments; Austin, TX, USA). For square-wave anodic stripping voltammetry (SWASV) measurements, a conventional three-electrode system was used. The paper/silver electrode was made in-house and used as the working electrode. Additional printed electrodes (model TE100) were acquired from CH instruments (Austin, TX, USA); these were used as a counter-electrode (carbon) and a reference-electrode (Ag).

2 Preparation of the PCL-coated paper

The 15% (w/v) PCL solution was prepared by completely dissolving bulk PCL pellets in toluene.[3] Whatman chromatography paper was soaked in the PCL solution, then dried at ambient temperature in a fume hood. The thin PCL film thus produced was used as hydrophobic fluidic barrier, an electrical insulator, and as an adhesion layer. Bonding occurs when the PCL layer reaches its melting temperature of 60 ˚C, allowing for complex 3-D devices to be made easily and quickly.

3 Electrochemical Cell

A glass beaker (10 mL capacity) was used as the electrochemical cell, including a fabricated laminated paper/silver electrode (LPSE) as working electrode, a printed carbon counter electrode, a printed silver electrode as pseudo reference electrode and a mixing magneton.

4 Figure S1

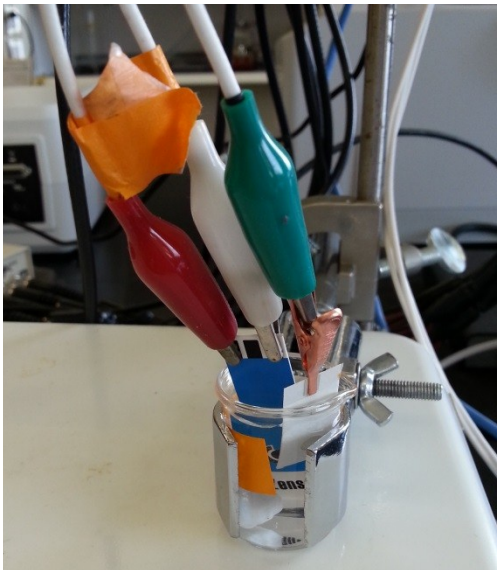

Fig. S1. The image of the electrochemical cell

5. Figure S2

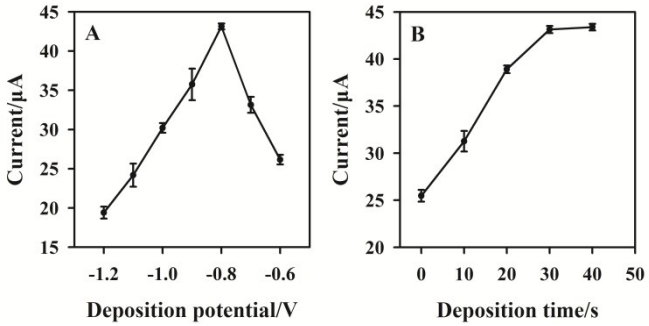

Fig. S2. Effect of deposition potential (A) and deposition time (B) on the peak current for lead ions. The concentration of lead ions in the solution for optimization of detection conditions is 10 μM. Error bars represent the standard deviations of three replicate experiments.

6 Table S1

Table S1 Recovery assays of Pb^{2+} in drinking water samples

sample	Added [nM]	Found [nM]	RSD [%]	Recovery [%]
1	0	ND		
2	100	98	5.8	98
3	200	196	4.0	98

4	300	284	1.3	95
5	400	413	3.3	103
6	500	516	1.7	103

[a]ND: not detectable.

References

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