

Determination of Pb^{2+} in natural water by polymer electrode coupled with a flow analysis device

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Supplementary Information

1 Preparation of the modified electrodes

The glass carbon electrode (GCE) was systematically polished using $\alpha\text{-Al}_2\text{O}_3$ powder with particle sizes of 1.0, 0.3, and 0.05 μm , followed by ultrasonic cleaning after each polishing step. A solution containing 4 mg mL^{-1} pyrrole and 3 mg mL^{-1} thiourea was prepared for electropolymerization via cyclic voltammetry (CV). The process involved a single scanning cycle with a starting potential of 0.0 V, a scan rate of 50 mV s^{-1} , and a potential range from 0.0 to 1.0 V. Subsequently, the resulting poly(pyrrole thiourea) electrode was thoroughly washed with ultrapure water and allowed to dry at room temperature. The polypyrrole-modified electrode was prepared following identical procedures but without the addition of thiourea.

Optimization of experimental conditions

The experimental parameters for detecting Pb^{2+} were optimized to obtain higher sensitivity. The pH value of buffer solution has obvious effect on the Pb^{2+} response current. As shown in Fig. S1b, in the pH range of 3.0 to 7.0, the current intensity increases with rising pH levels until reaching a pH of 5. A significant decrease in response current is observed when the pH exceeds 5, as Pb^{2+} readily forms hydrated ions at elevated pH values, which hinders detection. Consequently, a buffer solution with a pH of 5 was selected for further experiments.

The deposition potential and deposition time were also optimized during the experiment, with results presented in Fig. S1b. As the deposition potential gradually shifts from -0.7 V to -1.2 V, there

is a marked increase in the response current for Pb^{2+} ions. However, when the voltage falls below -0.8 V, the response current becomes unstable; thus, a deposition potential of -0.8 V was chosen for subsequent studies.

The effect of deposition time is illustrated in Fig. S1c, where it can be seen that the response current for Pb^{2+} exhibits an almost linear relationship with respect to deposition time. To facilitate rapid detection requirements, a deposition time of 240 seconds was selected. Additionally, we investigated how variations in flow rate within the electrochemical flow cell influence detection performance (Fig. S1d). Finally, we selected a flow rate of 8 mL min^{-1} .

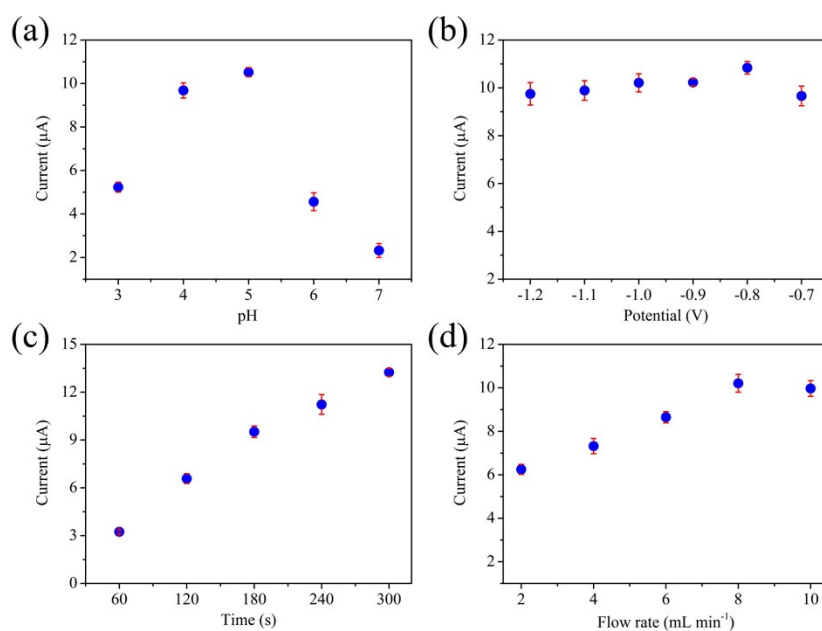


Fig. S1. Optimization the pH of buffer solution (a), the parameters of preconcentration potential (b), the preconcentration time (c), and the flow rate during preconcentration (d).