Supplementary

A Systematic Investigation on Synergistic Electroplating and Capacitive Removal of Pb^{2+} from Artificial Industrial Waste Water

Yang, Gui[a], Daniel John Blackwood[b,*]

The solution flow rate is calculated based on below equation

$$r_{flow} = \frac{V}{t \cdot gram\ of\ carbon\ used} \quad ml\ /\ (\min \cdot g)$$

Where t is the time duration starting from waste water inlet, passing through cell, conductivity meter and pH meter, ending at outlet. The trace is designated by arrows in Figure S1; V is the total volume of waste water during the time duration.

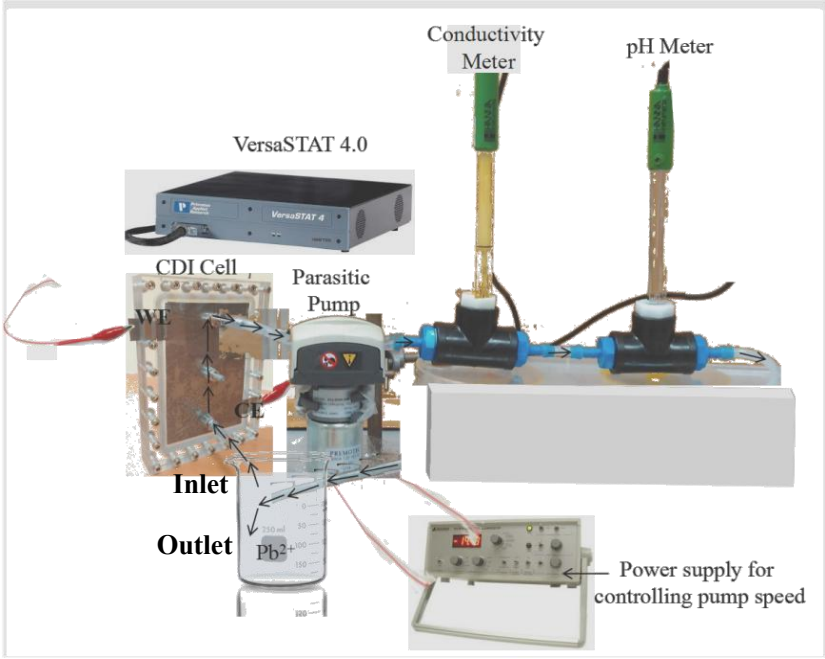

Figure S1 Schematic diagram of the testing system for the removal of Pb^{2+}

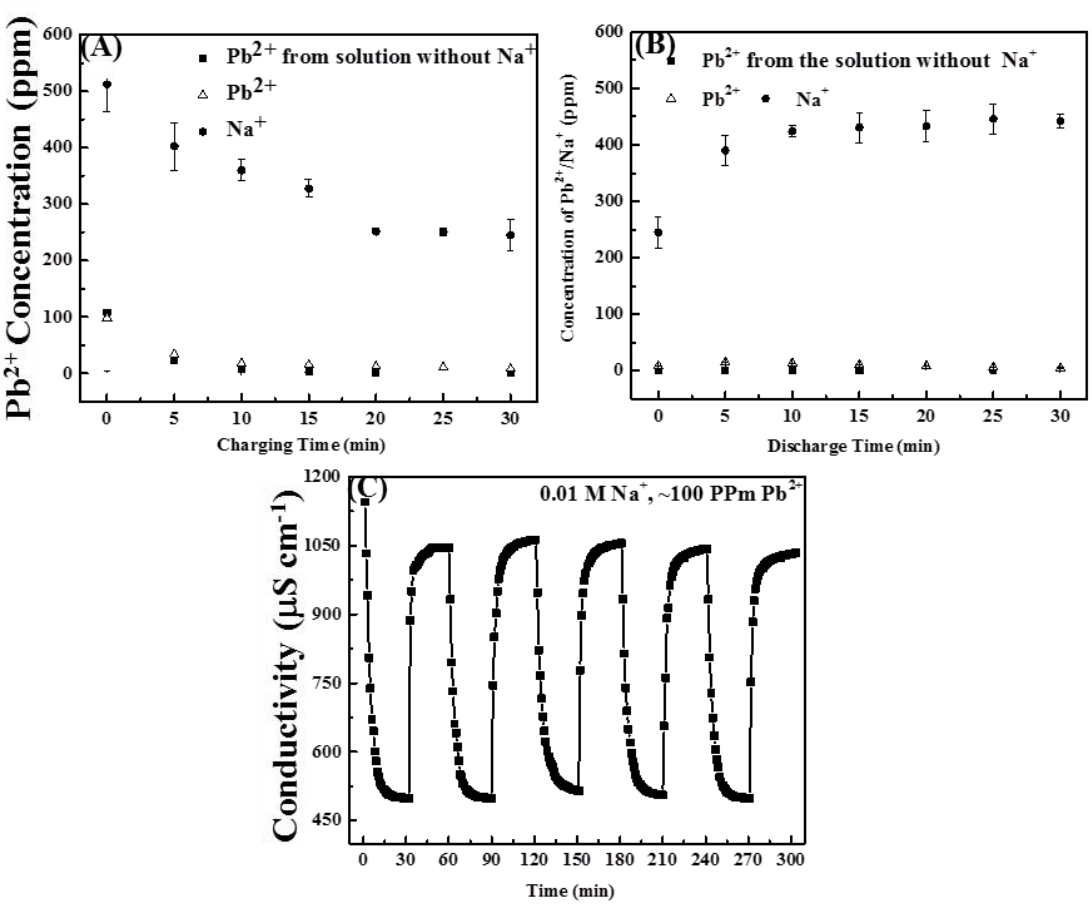

Figure S2 Concentration change of 100 ppm Pb^{2+} in multi-cations solution (500 ppm Na^{+}) during the first cycle of (A) charge and (B) discharge process; (C) Conductivity change of the solution with multi-salts ($Pb(NO_3)_2$, NaCl) under pumping rate of 70 ml/min and the substrate area of 10 cm × 15cm

Figure S2 displays the impact of multi-ions in the solution on the Pb^{2+} removal performanc. Through the analysis, it reflects that the removal performance of Pb^{2+} will not be interfered under the co-existence of Na^{+}. Additionally, the Na^{+} in the solution can be realized a total removal of 50% that is 100% reversible, which provides a view angle on Na^{+} seperation and collection.

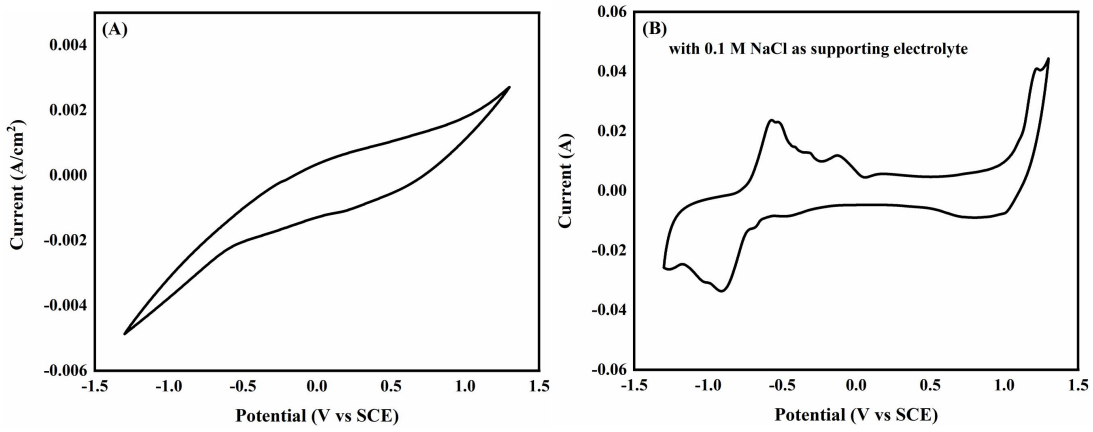

Figure S3 Cyclic voltammetry in 100 ppm Pb^{2+} solution with supporting electrolyte of (A) 0 M and (B) 0.1 M NaCl at a scan rate of 50 mV/s

Cyclic voltammetry was also shown in Figure S3, but the high resistance of the 100 ppm Pb^{2+} solution meant this were of little value with no clear redox peaks being observable. On the addition of 0.1 M NaCl as supporting electrolyte, redox couples that were consistent with Reactions (1) and (2) along with water splitting were obtained.

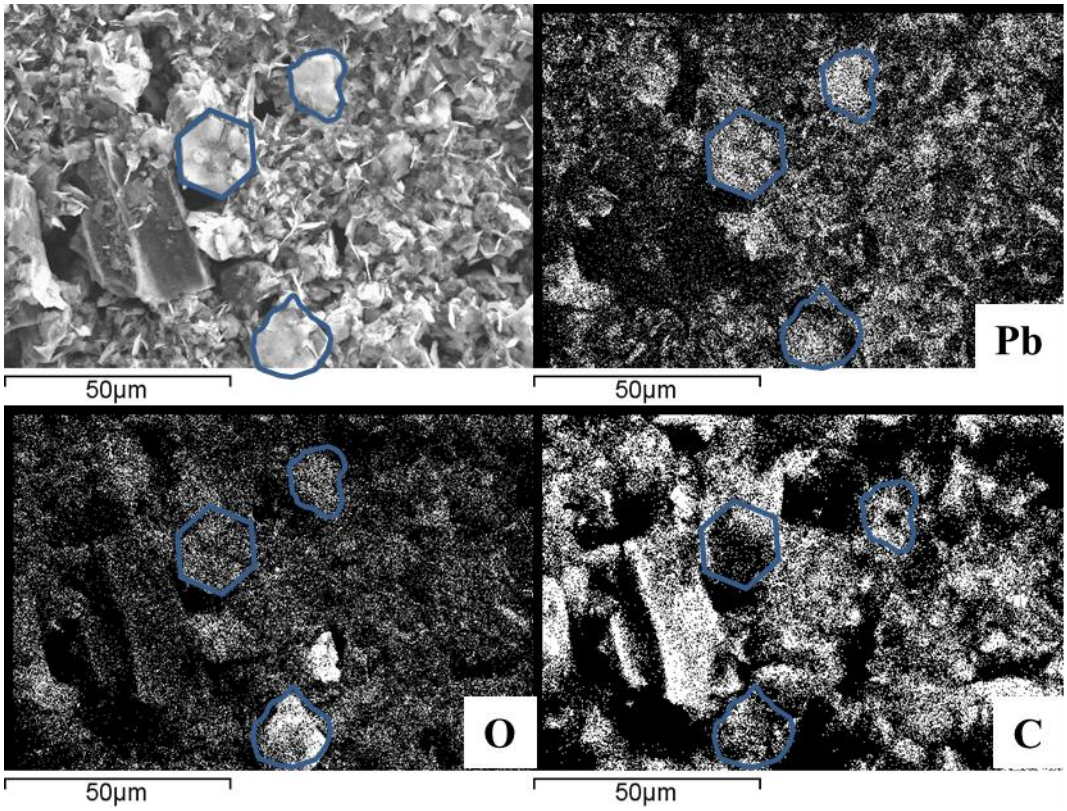

Figure S4 SEM-EDS analysis on the cathode after five cycles of charge/discharge process.

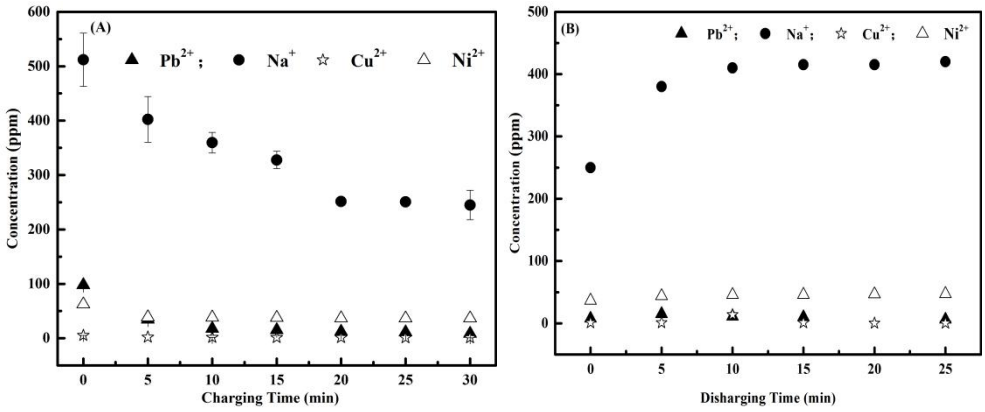

Figure S5 Concentration change of respective ion in the solution during (A) charging and (B) discharging process.

the competitive behavior between Pb^{2+} and other metals (Na^{+}, Cu^{2+} and Ni^{2+}) has been analyzed by dissolving 100 ppm Pb^{2+}, 0.1 M NaCl, 5 ppm Cu^{2+} and 62.5 ppm Ni^{2+} in 60 ml DI water, which is shown in Figure S5 and displayed below. When compared to

Figure 3, it can be seen that the co-existence of multi-ions did not significantly affect the removal efficiency of Pb^{2+} during the charging process. When at discharging state, only NaCl reflects a reversibility>90%, all the other heavy metals show a lower reversibility, which indicates the involvement of other electrochemical reactions; such as electroplating. This was included in the supplemental data in Figure S5 and also updated in the text.