

Supporting Information

for

Structural and Morphological Evolution of Lead Dendrites during Electrochemical Migration

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This file includes:

Figures S1-S6

Movies S1

Movie caption

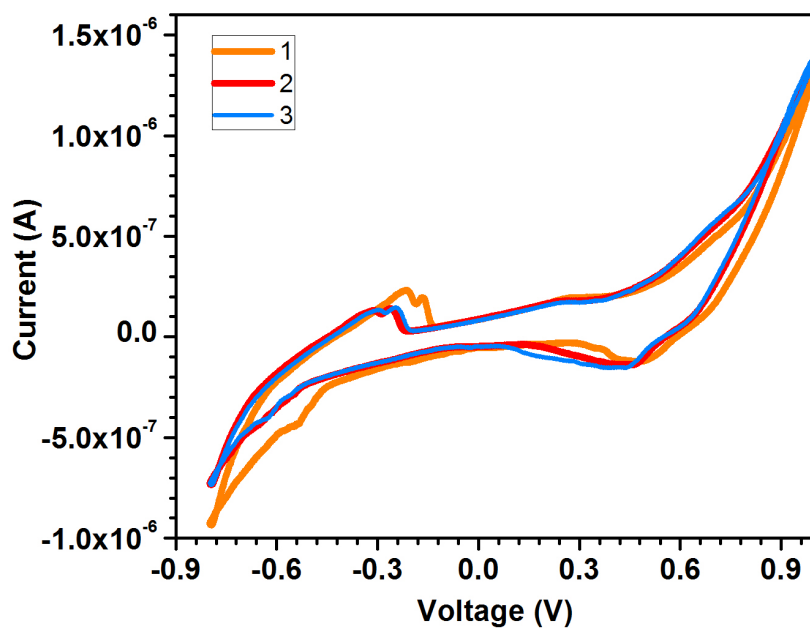


Figure S1 | Cyclic voltammograms recorded on a fully assembled and sealed biasing liquid cell outside TEM. The cell was loaded with 100 mg/mL lead nitrate solution, fixed in the TEM holder which was connected to an electrochemical workstation. It shows three cycles with reasonable reproducibility. The curves begin at a potential of 0 V, sweep from -0.8 V to 1.2 V and then back to 0 V at a constant voltage ramp rate of 20 mV/second. The plots show that the onset lead deposition occurs at about -0.48V followed by a current peak of $\sim 2 \times 10^{-7}$ A and the onset lead dissolution happens at about +0.48V with a current peak of $\sim 2.5 \times 10^{-7}$ A.

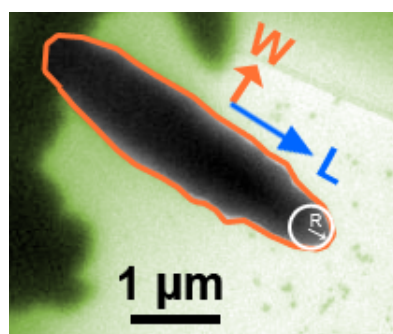


Figure S2 | Shape analysis of the needle, where W, L and R are the width, length and curvature of the tip, respectively.

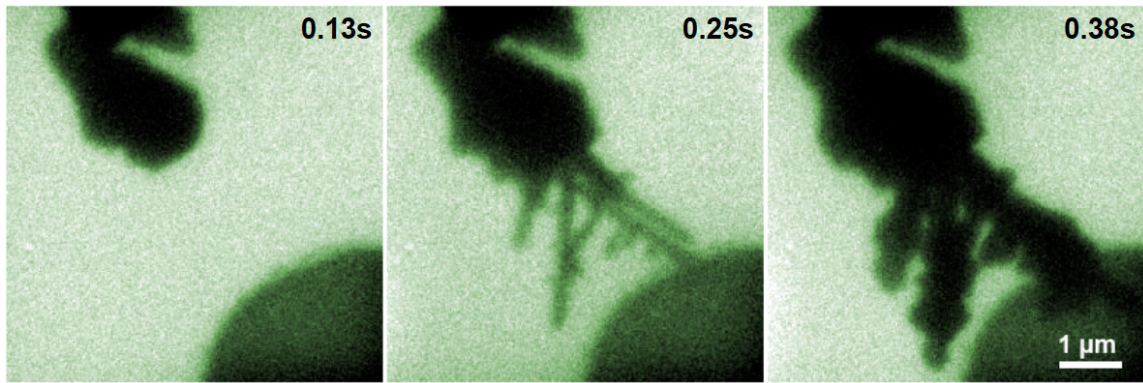


Figure S3 | Sequential images showing the growth of Pb dendrites induces short circuit of the device. The initial time is arbitrary.

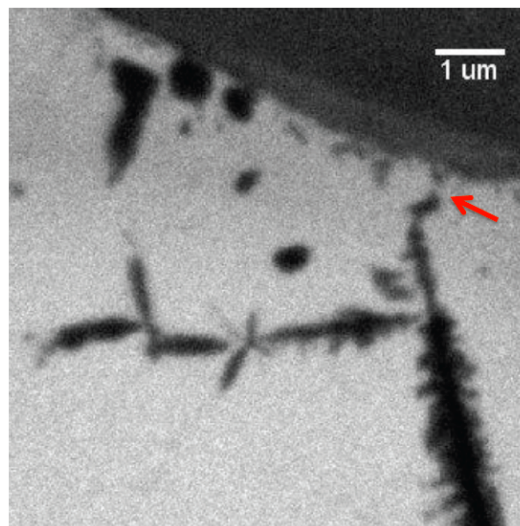


Figure S4 | The lead dendrite is disconnected from the electrode when the electric bias is reversed.

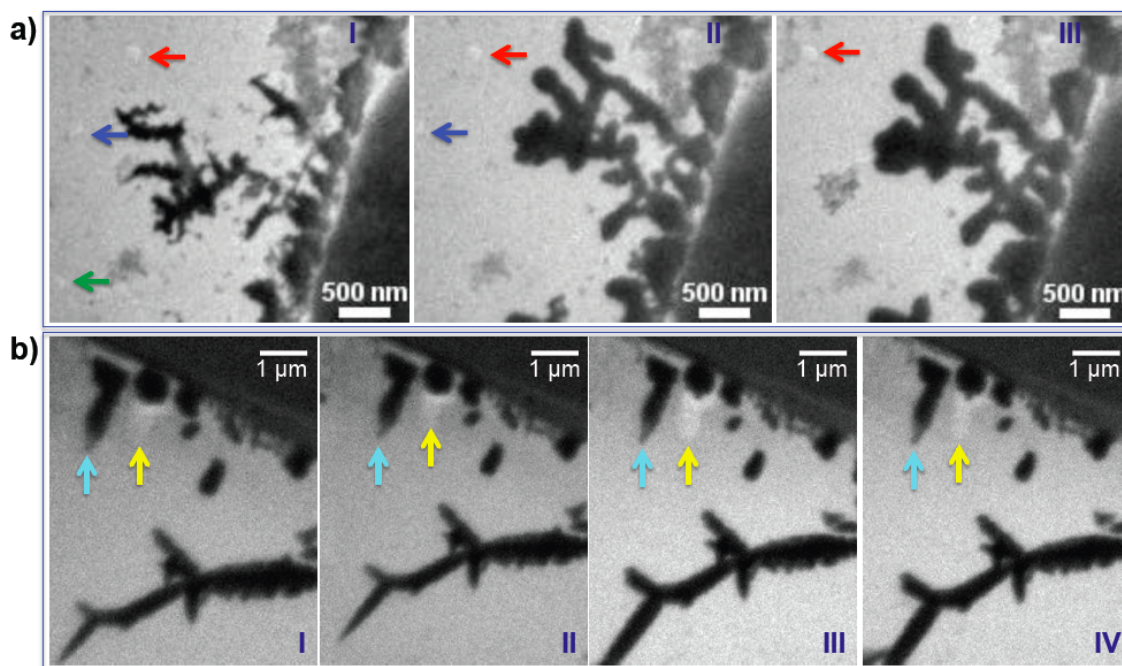


Figure S5 | Bubbles generated in the electrolyte. a) Sequential images showing bubble migration inside the electrolyte. Bubbles (highlighted by arrows) are likely generated from radiolysis of water. B) Sequential images showing a bubble (highlighted by a yellow arrow) at the solid-liquid interface grows and shrinks, which are synchronized with the neighboring lead branch (highlighted by a blue arrow) growth and dissolution. It is likely electrolysis of water is involved in the bubble generation.

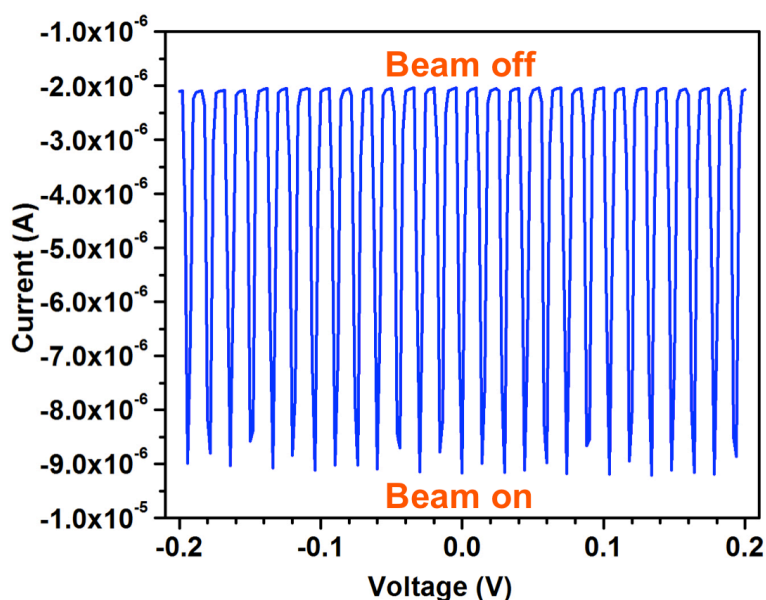


Figure S6 | TEM beam effects studied by blocking the beam periodically when measuring the electron current. The current with beam on is about 4.5 times of the one with beam off.

Movie Caption

Movie S1 | In-situ TEM movie showing deposition and dissolution of lead dendritic structure at cyclic voltammetry of -0.8 to 1.2 V and a scan rate of 20 mV/s. The lead concentration in the precursor solution of 100 mg/mL was used. Images drifts are corrected while the original contrast and brightness are maintained. Movie plays 6 times slower than real time.