

Observation of Lithium dendrite growth by in situ Transmission X-ray Microscopy and Optical Microscopy

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Abstract

In recent years, rechargeable metal batteries have attracted numerous research studies for the increasing demand of energy storage systems. Among them, lithium metal batteries (LMB) have been recognized as the holy grail in secondary batteries. However, dendrite formation and dead Li are serious issues at the anode electrode, which result in low coulombic efficiency and are the culprit safety issue, still hinder the practical application of LMB. Therefore, both industry and academia are working hard to mitigate the irregularities of lithium dendrite growth and unify the surface morphology. Here in, lithium dendrite growth is observed by high spatial and time resolution Transmission X-ray Microscopy (TXM) under various current density (2, 5 mA/cm²) with the fixed Q = 1mAh. The evolution of the dendrite morphology and dead lithium is revealed by *in-situ* TXM techniques. In addition, we also perform *in-situ* optical microscopy (OM) to prove that the results echo with each other. The results show that lithium growth under high current density conditions tends to show needle-like structure. The finding of this work demonstrates TXM as a useful tool for in-situ dynamic visualization and quantitative measurement of lithium plating and dendrite morphology. Most importantly, the mechanism of dendrite growth can be directly investigated and observed by *in-situ* TXM techniques, which can shed lights on the future studies of lithium dendrite suppression.

Keywords- *Lithium; dendrite; In-Situ; TXM; OM; LMB*