

Electrodeposition and electrochemical dissolution of Li metal on an ultra-micro-electrode

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Dendrite growth of Li metal is very large obstacle to utilize Li metal electrode as secondary battery anode. In order to restrict the dendrite growth of Li metal during cycles, it is very indispensable to understand the mechanism of the electrodeposition and electrochemical dissolution of Li metal. In general, the reactant concentration (Li^+ ion), temperature, applied current density and existence of additives are parameters of the morphological variation of electrodeposited metal. In case of Li metal system, solid electrolyte interphase (SEI) is formed on the Li metal surface, and the SEI is also very important parameter to discuss the dynamics of electrodeposition and electrochemical dissolution. In other words, the existence of SEI complicates the electrochemical behavior of Li metal. Although there are many researches about Li metal electrode, the knowledge for dendrite growth of Li metal is not enough to control the morphological variation in the electrochemical cell. In this study, ultra-micro-electrode (UME) technique was utilized to study the morphological variation of electrodeposited and cycled Li metal electrode. The advantages of UME are not only to minimize the effect of concentration profile near the electrode but also to be possible to observe the entire electrode surface by ex-situ microscopic observation with high magnification. Fig. 1 shows the SEM images (top view and cross sectional view) of the electrodeposited Li metal from 1M $\text{LiPF}_6\text{-EC:DEC}$ (=1:1 vol) electrolyte. Applied current density was 2.0 mA cm^{-2} , and electrodeposition time is 1 hour (2.0 mAh). The electrodeposited Li metal was very smooth and very uniform with column shape, because the Li^+ supply was under semispherical diffusion mode. In this study, the effect of electrolyte composition (solvent, Li salt, concentration) to the deposited Li morphology will be discussed and the electrodeposition mechanism will be suggested.

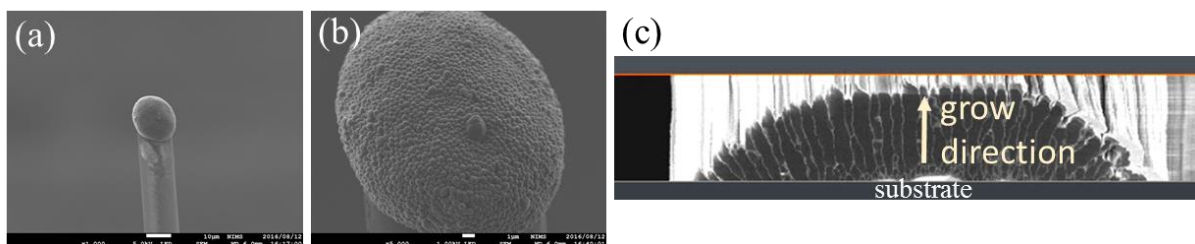


Figure 1. SEM images of electrodeposited Li metal onto UME in 1M $\text{LiPF}_6\text{-EC:DEC}$ (1:1) electrolyte. Applied current density was 2.0 mA cm^{-2} . (a) low magnification image, (b) high magnification images, and (c) cross sectional images obtained by orthogonal FIB-SEM.

References:

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