

Interferometry Study for Li Metal Anode

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Li metal is very attractive anode candidate for next-generation batteries because Li metal has very large specific capacity and Li/Li⁺ potential is the lowest. However, Li metal has also a severe problem for application to the anode of batteries. Repeating charging and discharging operation induces the irreversible surface morphological change. The morphological variation causes the low coulombic efficiency and short-circuit phenomenon in the worst case. In order to utilize Li metal anode for next-generation batteries, it is indispensable to control the surface morphological variation during cycles. In this study, the morphological variation of Li metal electrode in the electrodeposition is discussed from the viewpoint of Li⁺ ionic mass transfer rate in the vicinity of the Li metal electrode. In general, metal electrodeposition and deposited morphology is strongly affected by the electrode surface concentration. However, there are only a few researches in the Li metal electrodeposition system focused on such ionic mass transfer phenomenon. Our previous researches have showed the Li⁺ concentration profile near the Li metal electrode during electrodeposition and electrochemical dissolution by using in-situ holographic interferometry technique. It was revealed that typical Li metal dendrite forms without the depletion of Li⁺ ion at the electrode surface, but the depletion of Li⁺ ion accelerates the dendrite growth. However, the interferometry equipment did not have enough space resolution to detect the concentration gradient around a Li dendrite. Here, digital holographic interferometry microscope is utilized to visualize the Li⁺ concentration profile near Li metal electrode. Fig.1 shows the Li⁺ concentration profile near the Li metal electrode in solvated ionic liquid electrolyte (LiTFSA:tetraglyme = 1:1). Not only Li⁺ surface concentration but also concentration boundary layer thickness are focused to discuss the Li⁺ ionic mass transfer phenomenon in this study. Especially, solvated ionic liquids are new concept electrolyte and then it is very important to understand the ionic mass transfer in the solvated ionic liquid. We would like to discuss common and different points with normal concentration electrolytes (about 1mol dm⁻³). Furthermore, the relationship between the morphological variations of electrodeposited Li metal and the developing the concentration profile in solvated ionic liquids systems will be discussed.

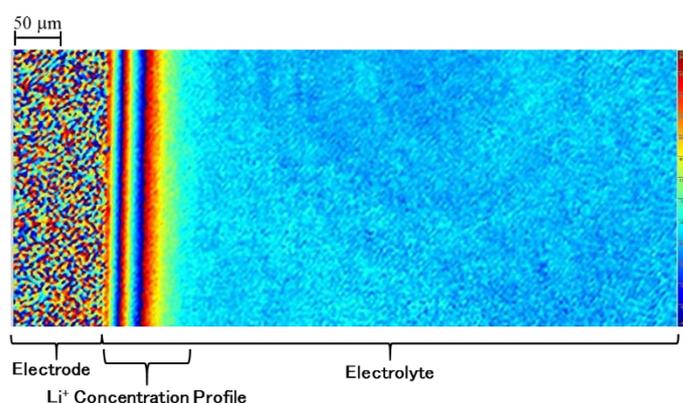


Figure 1. Digital holographic microscope images in the vicinity of the Li metal electrode. Applied current density for electrodeposition of Li metal was 3 mA cm⁻². It was recorded at 100 seconds.

References:

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