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著者(和文)	ZHOU HUANGKAI
Author(English)	ZHOU HUANGKAI
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OUTLINE

The solid-liquid electrolyte interfacial structure was investigated by neutron reflectometry (NR) to elucidate the impacts of surface modification and electrolyte composition on the lithium intercalation rate. The $LiCoO_2$ film produced by the PLD method is an extremely smooth epitaxial film with a (104) orientation and a surface roughness of approximately 1 nm, which is suitable for simplifying the observation of interface phenomena with organic electrolytes. A double-interfacial layer was observed between the cathode and the electrolyte interface. The interfacial layer formed on the surface of Li_2ZrO_3 modification $LiCoO_2$ accelerated the desolvation and surface adsorption of lithium ions in the electrolyte and improved the intercalation rate. The electrolyte composition can tune the composition of the interphase, which can affect the interfacial structure and the intercalation rate. In situ NR is a highly useful technique for observing interfacial structures during battery cycling, as it simultaneously offers both chemical composition and morphological insights. This method is particularly effective in elucidating the complicated mechanisms of battery reactions.