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ABSTRACT:

Operando Observation of Bipolar Diffusion of Ions and Electrons in Solid Oxide Cell Electrolyte by Using Micro-X-Ray Absorption Spectroscopy

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Electrochemical devices using a solid electrolyte, such as solid oxide cells using a solid-state oxide-ion (SOC) or proton conductor (PCC) and all-solid-state batteries using a solid-state lithium-ion conductor (ASSB), are expected as next-generation energy conversion and storage devices. In such solid-state ionics devices, the difference in chemical potential of reaction component, which is maintained across the electrolyte between the cathode and the anode, is the driving force for ionic diffusion and reaction. Therefore, it is important to understand the chemical potential distribution in solid electrolyte under operation.

So far, a lot of numerical studies have been carried to estimate the chemical potential distribution in solid state ionics devices [1]. However, only a few studies have been reported to directly observe the distribution of chemical potential in an experimental manner [2], and as far as the authors know, there exist no studies for its operando observation under device operation. In this study, we aimed to experimentally evaluate the chemical potential distribution in SOFC/SOEC under operation. And the obtained results were compared with the simulated results based on the bipolar diffusion of ion and electron in the electrolyte.

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