Contribution ID: **63** Type: **Invited/plenary talk**

INVITED: In-situ/Operando Observation of Electrochemical Reactions in All-solid-state Thin-film Lithium-Ion Batteries by Laboratory-based XPS Apparatus

Thursday 8 December 2022 08:30 (30 minutes)

All-solid-state lithium-ion battery (ASSLIB) is a promising next generation rechargeable battery because of its high safety and reliability. Understanding of the electrochemical reactions and accompanying structural changes is important to develop high-performance materials and cell structures. Because ex-situ measurements may result in misinterpretation due to the variation of samples and undesired side reactions during sample transfer, in-situ/operando measurements of the same position of the same sample are essential for comprehensive understanding. Recently, we developed in-situ/operando XPS and HAXPES apparatuses equipped with a bias application system and observed the electrochemical lithiation/delithiation reactions of an amorphous silicon thin film electrode sputter-deposited on a solid electrolyte sheet. Upon lithiation, not only lithium silicides but also lithium oxides, lithium silicates and lithium carbonates were formed due to the insertion of lithium into the silicon electrode and native oxide, followed by side reactions of those surface species with residual gasses in the vacuum chamber. Although lithium silicides reversible responded to the successive delithiation, lithium oxides, lithium silicates and lithium carbonates maintained at the surface as irreversible species. Interestingly, a drastic shift of lithium silicide peak was observed in the successive delithiation after preceding lithiation up to certain level. This is attributed to the phase transition of a crystalline lithium silicides to an amorphous phase. Further details and a few other works will be presented.

References
[1] R. Endo, T. Ohnishi, K. Takada, and T. Masuda, "In Situ Observation of Lithiation and Delithiation Reactions of a Silicon Thin Film Electrode for All-Solid-State Lithium-Ion Batteries by X-ray Photoelectron Spectroscopy" , J. Phys. Chem. Lett. 2020, 11, 6649–6654.
[2] R. Endo, T. Ohnishi, K. Takada, T. Masuda, "Instrumentation for tracking electrochemical reactions by x-ray photoelectron spectroscopy under conventional vacuum conditions", Journal of Physics Communications, 2021, 5, 015001.
[3] R. Endo, T. Ohnishi, K. Takada, T. Masuda, "Electrochemical Lithiation and Delithiation in Amorphous Si Thin Film Electrodes Studied by Operando X-ray Photoelectron Spectroscopy", J. Phys. Chem. Lett. 2022, 13, 7363-7370.

if "Other", please specify:

I apply for a travel grant

No

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Track Classification: Electrochemistry/electrocatalysis