High-Capacity Anodes for All-Solid-State Lithium Batteries Using In-Situ Formed Solid Electrolyte

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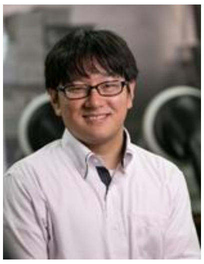

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Short Biography

Atsushi Inoishi is Associate Professor of Chemistry and Materials Science at Kyushu University. He holds a BS in Education and MS in Education from Tokyo Gakugei University, and PhD in Engineering from Kyushu University –, Japan. His specific research interests are in Battery Materials, including Oxide, Sulfide, Hydride and Halide. He has been funded for several research projects from government and industry in Japan. He was awarded by The Japan Association for Chemical Innovation in 2019. He has more than 60 journal articles and has been an invited speaker on numerous occasions at academic institutions throughout the world and at national and international conferences.

Title

High-Capacity Anodes for All-Solid-State Lithium Batteries

Using In-Situ Formed Solid Electrolyte

Abstract

Magnesium compounds such as MgH_2 undergo conversion reactions, during which lithium salts with ionic conductivity are generated. By utilizing these salts as ion conduction pathways, it is possible to carry out charge and discharge processes without pre-incorporating solid electrolytes into the electrode, thereby enhancing the actual capacity of all-solid-state batteries. I have named this approach the "in situ formed electrolyte" and have been researching it using various compounds. The insertion of Li^+ into $Mg(BH_4)_2$, MgH_2, $MgCl_2$, TiH_2 and $Ca(BH_4)_2$ occurs via the following electrochemical reactions: [1-7]

$$Mg(BH_4)_2 + 2Li^+ + 2e^- \rightarrow 2LiBH_4 + Mg \quad (1)$$

$$MgH_2 + 2Li^+ + 2e^- \rightarrow 2LiH + Mg \quad (2)$$

$$MgCl_2 + 2Li^+ + 2e^- \rightarrow 2LiCl + Mg \quad (3)$$

$$TiH_2 + 2Li^+ + 2e^- \rightarrow 2LiH + Ti \quad (4)$$

$$Ca(BH_4)_2 + 2Li^+ + 2e^- \rightarrow 2LiBH_4 + Ca \quad (5)$$

Lithium salts such as $LiBH_4$, LiH, and $LiCl$ generated through these reactions can be used as ion conduction pathways. In the case of TiH_2, since it possesses high electronic conductivity, even the carbon in the electrode can be eliminated. The lithium insertion process into TiH_2 was successfully

observed through SEM analysis using windowless EDS, revealing the formation and distribution of LiH.[8]

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