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All Solid-State Batteries Using Sulfide Inorganic Conductors and Lithium-Metal Anode

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Abstract

Lithium-ion batteries (LIB) were first commercialized in 1991, and since then the market has grown with the increase in demand of IT mobiles. Recently, the need for better batteries has continued to grow with ever increasing demands for even larger capacity and higher energy density for smart phone, tablet and EV applications. However, the energy density of conventional LIBs is now approaching the theoretical limit. Therefore, the next generation batteries are of great technical interest today. About 30 years ago, lithium metal secondary batteries were launched into the market, due to their high theoretical capacity of approximately 3,862 $mAhg^{-1}$. However, there were several incidents of combustion and explosion of lithium-metal batteries in 1989 and their safety became a serious issue. This led to research and development of safer lithium batteries based on i) lithium-ion batteries with rocking chair type with insertion-desertion reactions, ii) stable materials for the cathode, separator, and electrolyte (e.g., polymer, inorganic, ionic liquid) and iii) safety functions such as cell packaging and inclusion of a positive temperature coefficient thermistor. However, to satisfy the increasing demand for high energy density, there is a resurgence of interest in batteries with a lithium metal anode. This presentation will cover our recent work on the development of lithium metal secondary batteries using sulfide solid electrolytes. Sulfide based solid-state batteries have several great advantages such as (1) small grain boundary resistance, (2) fast kinetics at the Li/solid electrolyte interface, (3) stable cycle performance with a lithium metal anode, and (4) being based on a non-volatile and incombustible electrolyte [1-4]. These approaches offer a promising alternative for realizing a safe battery system with high energy density.

References

[1] S. Ito, et al., *J. Power Sources* **248** (2014) 943; [2] M. Agostini, et al., *Solid State Ionics* **244** (2013) 48; [3] T. Yamada, et al., *J. Electrochem. Soc*. **162** (2015) A646; [4] Y. Aihara, et al., *Frontiers in Energy Research* **4** (2016), Article 18.

Profile

Dr Yuichi Aihara has been working as a Principal engineer at Samsung R&D Institute Japan (SRJ) since 2003. He joined in SRJ in 2003 and developed “High temperature polymer electrolyte membrane fuel cells (HT-PEMFC)” for residential co-generation systems. Since 2010, he has been developing all solid-state batteries. Dr Aihara received his PhD degree in 2001 from the Mie University and also worked on the development of solid-polymer electrolytes and their application to all solid polymer batteries at Yuasa corporation (presently GS Yuasa), from 1991 to 2003.

Staff and students at all levels are welcome to attend.

Venue and Time:

This talk will be held on Tuesday August 16 at 2 pm at the Campbelltown Campus in Building 21, Lecture Theatre 5 (CA.21.G.03).

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