

Low-Temperature Charge/Discharge Mechanism in Li Ion Battery Anodes

Background

Li ion rechargeable batteries are widely used in consumer applications, such as mobile devices and vehicles, but also in harsh environments such as space. To suppress degradation and ensure safety, they are preferably used under certain thermal conditions. Consequently, it is required to control the temperature of the battery within a certain range, for example, between 0°C and 45°C, by heating or cooling.

A Li ion rechargeable battery mainly consists of a cathode, anode, electrolyte, and a separator. At SEL we are conducting R&D on materials for these components to improve battery safety, capacity, and lifetime.

One of our achievements is a battery that can be charged and discharged at -40°C, thanks to an anode composite material consisting of graphite, which has favorable charge/discharge cycle characteristics with small degradation, and Si, which enables charging/discharging at -40 °C. Si is a well-known, high-capacity anode active material, but the fundamental principles behind its good low-temperature characteristics are not yet well understood. More research is therefore required.

Goal

The goal of this project is to clarify the role of Si as an active anode material in Li insertion/extraction at low temperatures. Through this project you will learn about the manufacturing process of Li ion rechargeable batteries, and discoveries of the fundamental anode properties of Si may lead to patent applications and academic paper publications.

Tasks

1. Discuss and decide the experimental conditions. Materials will be provided by SEL.
2. Design and fabricate batteries by changing the type and amount of electrolyte.
3. Measure the battery charge/discharge characteristics at various temperatures.
4. Create a database of the results.
5. Explain the chemical reactions and effects of each anode material candidate.
6. Repeat steps 2-5.

Required Qualifications

- Experience in using glove boxes and charge/discharge testers.
- Careful attention to safety when handling hazardous materials that are unstable and flammable in ambient atmosphere.
- Outstanding knowledge in electrochemistry, organic chemistry, or a related field.
- Programming skills, such as Python or Excel macros, for data collection.
- Ability of accurately entering and extracting data of a predetermined format for determining experimental conditions.
- English communication skills (Japanese skills are desirable but not required).

Contact information

This project is hosted by SEL. Students are invited to apply for a scholarship from SEL through the [Sweden-Japan Foundation](#). For more information, please visit the SEL [web site](#) or contact the SEL public relations team at info@sel.co.jp.