The 105th GREEN Seminar

High-Rate and High-Efficiency Molten Salt Li-O_2 and Na-O_2 Batteries Enabled by Nitrate Redox

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The decarbonization of the electrical grid requires advancements in affordable, long-term energy storage to address the intermittency of energy sources like solar and wind, while the continued decarbonization of the transportation sector necessitates advancements in energy-dense storage devices such as batteries, with low cost and made from abundant materials. Alkali metal-oxygen batteries can provide greater specific energy than Li-ion batteries and can potentially lower costs by reducing reliance on late-transition metals like nickel and cobalt. In this talk, recent work on molten-salt Li-O_2 and Na-O_2 batteries is shared, which operate at 150-170 °C and can deliver high areal energy (33 mWh/cm^2_{geo}) and power densities (19 mW/cm^2_{geo}), with high energy efficiency (~90% at 5 mA/cm^2_{geo}). Nitrate redox is shown to play a critical role in these batteries, where the apparent four-electron oxygen reduction to form Li_2O in Li-O_2 batteries is facilitated by the electrochemical reduction of nitrate to nitrite, and subsequent chemical oxidation of nitrite to nitrate by molecular oxygen. In Na-O_2 batteries, on the other hand, Na_2O is re-oxidized by O_2 to form Na_2O_2 and give an apparent two-electron oxygen reduction reaction. The role of transition metal oxide catalysts in reducing the overpotential of nitrate redox in the positive electrode is discussed, as well as strategies for enhancing the power density and specific energy of these molten-salt metal-oxygen batteries.

Venue: Rm. 409/410, 4F, Collaborative Research Bldg., Namiki-site

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