Contribution ID : **12**

Type : **Oral**

Dynamic Lithium Diffusion in Lithium Batteries studied by Rapid Neutron Tomography

Monday, 3 September 2018 15:50 (20)

Lithium batteries are considered one of the most transformative technologies of the 20th century. They are a reliable power source for portable devices which are used every day by billions of users, such as mobile phones, laptops, pacemakers and increasingly in electrical vehicles. Lithium batteries have high energy density and capacity, superior reliability and long shelf life of up to 20 years. This makes them the best choice for applications in extreme environments.

It is essential for the development of the next generation lithium batteries to have a deeper understanding of the macroscopic lithium diffusion processes insight the batteries during dynamic discharging to elucidate mechanisms which reduce the battery performance. To obtain such information three-dimensional imaging techniques, such as X-ray tomography, are state of the art. However, for direct imaging of lithium, X-ray techniques are often unsuitable due to the high transparency for low-atomic number elements like lithium. Neutrons offer a superior alternative with a high sensitivity for lithium, but neutron tomography suffers from insufficient spatial and temporal resolution. During the last decade, however, new high reflective neutron guides and high sensitive neutron camera systems have led to a significant reduction in the acquisition times. We present time resolved in-operando neutron tomographies of the lithium diffusion process inside a commercial lithium – thionyl chloride battery (LS14250 from Saft) during discharging. The continuous three-dimensional imaging, with 10 minutes exposure time per tomogram, enables the visualisation of the lithium removal from the lithium-metal electrode and the lithium diffusion inside the thionyl chloride cathode. The experiment allows quantification of the removed lithium from the electrode as a function of time and correlate with electrochemical performance. Furthermore, the evolution of SO_2 gas is detected which insulate regions on the anode and hinders the diffusion process in the cathode. Such processes can lead to a significant reduction in the capacity and performance of the battery. Our experiment demonstrated that neutron tomography is a powerful tool to image dynamic process in lithium batteries with a sufficient time resolution of the dynamic processes. Future work will focus on the application to a range of Li-ion chemistries and will seek to explore the degradation processes associated with long term operation and operation in extreme environments.

Primary author(s) : Mr ZIESCHE, Ralf (Electorchemical Innovation Lab, Department of Chemical Engineering, University College London, Torrington Place, London)

Co-author(s) : Dr KARDJILOV, Nikolay (Helmholtz Zentrum für Materialien und Energie, FG-GTOMO, 14109 Berlin, Germany); Dr MARKOETTER, Henning (Helmholtz Zentrum für Materialien und Energie, FG-GTOMO, 14109 Berlin, Germany); Prof. SHEARING, Paul (Electorchemical Innovation Lab, Department of Chemical Engineering, University College London, Torrington Place, London); Prof. BRETT, Dan (Electorchemical Innovation Lab, Department of Chemical Engineering, University College London, Torrington Place, London); Dr KOCKELMANN, Winfried (STFC, Rutherford Appleton Laboratory, ISIS Facility, Chilton, OX11 0QX, UK)

Presenter(s) : Mr ZIESCHE, Ralf (Electorchemical Innovation Lab, Department of Chemical Engineering, University College London, Torrington Place, London)

Session Classification : Speaker Sessions and Seminars

Track Classification : Material Science