

## 15th International Conference on Muon Spin Rotation, Relaxation and Resonance



Contribution ID: 130

Type: Poster

### The BAM cell: an electrochemical device for operando ionic diffusion measurements using muon spectroscopy

*Monday, 29 August 2022 18:40 (20 minutes)*

Understanding the complex ways that battery materials change on charging and discharging is vital for improving their function in operation, but traditional ex-situ muon measurements have barely scratched the surface of this deep mine of information. Here, we present an electrochemical cell that enables ionic diffusion measurements using muon spectroscopy ( $\mu$ SR) at the ISIS Neutron and Muon Source. Traditional ex-situ powder  $\mu$ SR measurements provide valuable fundamental properties, but they often do not investigate important ionic diffusion pathways which are only established during battery operation as charge is (de)intercalated to/from the structure. Operando experiments have the potential to follow the rate of atomic-scale ionic motion in functioning batteries, allowing the influence of structural phenomena which occur during charging/discharging, such as phase changes or lattice contractions, to be determined. The Battery Analysis by Muon (BAM) cell is described here as a simply assembled, electrochemically reliable device, which provides comparable performances to commercially available equivalent devices and can be used to study a variety of cell chemistries. The cell's suitability for  $\mu$ SR measurements is demonstrated by an example operando experiment on a Li-ion half cell with cathode material NMC811, which produced high quality data from the specimen of interest. This experiment outlined the benefits of  $\mu$ SR to follow ionic diffusivity properties during charging/discharging and uncovered a link between the material phase transitions and the measured field distribution width. Such results facilitate further development of our operando methodology, with a range of future applications of the BAM cell available for exploration.

**Primary authors:** MCCLELLAND, Innes (University of Sheffield); BAKER, Peter (STFC)

**Presenter:** MCCLELLAND, Innes (University of Sheffield)

**Session Classification:** Posters

**Track Classification:** Energy materials