Inside-Out MRI for Diagnosing Rechargeable Batteries

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One of the biggest obstacles to progress in battery technology is the limited amount of information that one can obtain from the battery mechanism without taking it apart. Here we are presenting a novel nondestructive battery assessment technology that is capable of obtaining crucial information from batteries even when the cells are encased in conductive material. The technique, based on magnetic resonance imaging (MRI), allows measuring the magnetic susceptibility of active ingredients inside an electrochemical cell, and how it is affected by the oxidation state of the materials to give insights into the state of charge (SOC) of the battery, and defects. Figure 1 shows we were able to capture the battery SOC as it was going through a full electrochemical cycle. The technique has been demonstrated on various cell types, with different defects and chemistries.

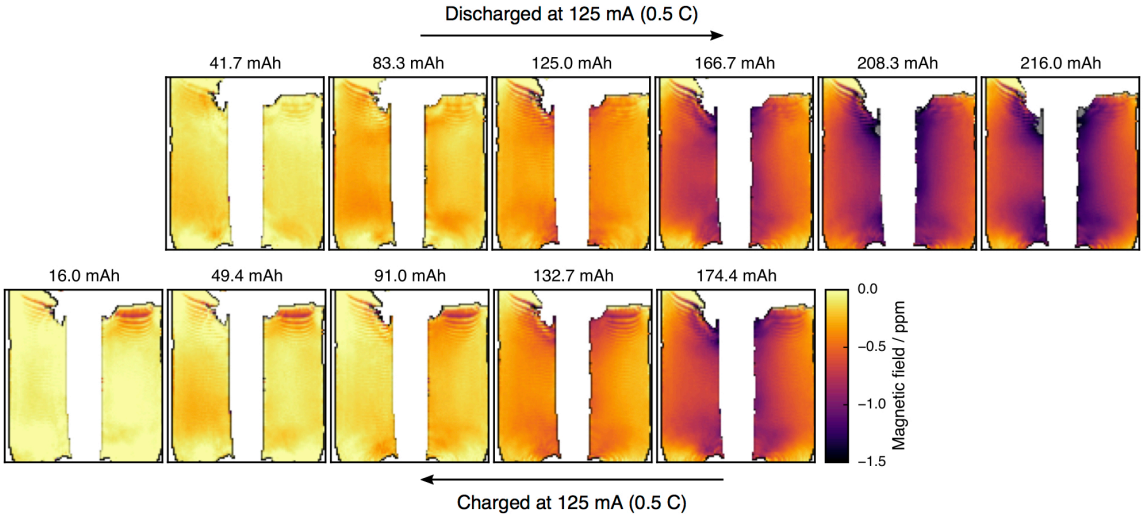

Figure1. Magnetic Resonance Image of the medium around the battery at different state of charge of the battery.

Furthermore, current distributions within cells can also be measured with this approach. Figure 2 depicts how the magnetic field generated by current flowing inside the battery changes by state of charge of the battery. This indirectly indicates how the current distribution changes as the sate of charge. The measurement is fast (a couple of seconds), and could be adapted to a range of cell types. The technology also enables new opportunities for assessing cells that have undergone accelerated life or high stress testing. We lay out our vision for how this new noninvasive methodology will provide much-needed tools for the development of next-generation battery materials and cell designs that address current and future needs.

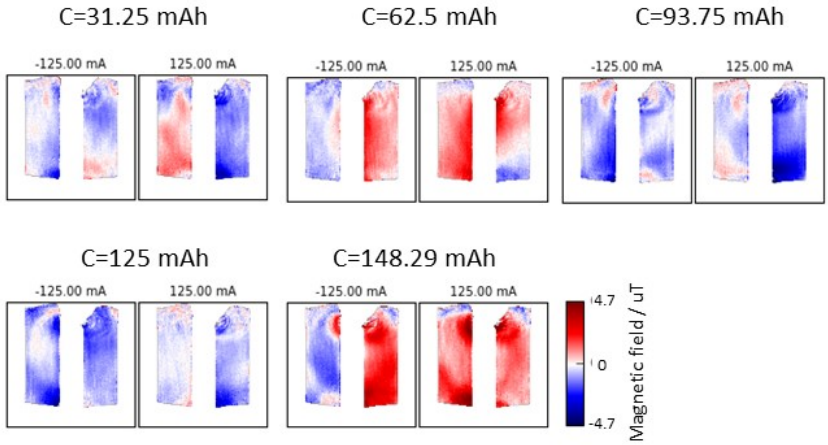

Figure 2.Magenic field generated by the current inside the battery while the cell was bing charge and discharge at 100mA at different state of charge

References:

A. J. Ilott, M. Mohammadi,C. M. Schauerman, M. J. Ganter, A. Jerschwow, *Nat. Comm*, 2018, 9, 1776