^{7}Li MRI of Battery Materials at 11.75 T

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Introduction

Batteries are ubiquitous. The immense popularity and ever increasing demand for Li-ion batteries (LiBs) has spurred vigorous research to find new materials with increased capacity, stability and cycle life. However, the enthusiasm for commercial use of Li metal in LIBs is curbed by safety issues arising from dendritic or mossy Li formation. An attendant need for noninvasive, analytical tools has never been more pressing. MRI is such a diagnostic tool with unquestioned success in medical field, but sparsely used in batteries. Its use for monitoring batteries with metal electrodes, save for one instance [1], has not been exploited. We currently are developing this field, which enables us to see inside batteries; it has potential appeal to a world-wide community of battery and energy research.

Results and Discussion

Figure 1 from Ref [1] displays ^{7}Li MRI at 194.4 MHz (11.75 T) of a symmetric Li metal bagcell battery (with LiPF6 in EC/DMC electrolyte), in pristine and after charging for 4 hours at 440 μA, revealing buildup of lithium microstructure at the charged electrode. Battery MRI as a function of charging will help determine the locations of Li metal deposits under different electrochemical conditions, which in turn will aid in the optimization of improved energy storage structures.

Figure 2 shows ^{7}Li MRI at 194.4 MHz (11.75 T), acquired at the NHMFL, of an asymmetric Li metal battery phantom in pristine state. One of the Li electrodes is enriched with ^{6}Li instead of ^{7}Li and is not visible in the MRI.

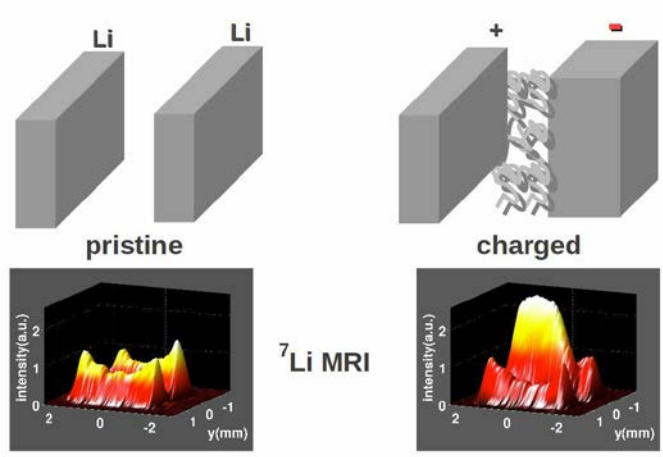

Figure 1: ^{7}Li MRI at 11.75 T of a symmetric Li metal bagcell battery, in pristine and after charging for 4 hours [1].

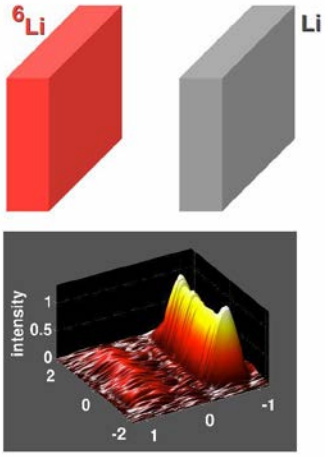

Figure 2: ^{7}Li MRI at 11.75 T acquired at the NHMFL of an asymmetric Li metal battery phantom in pristine state.

Conclusions

Much higher resolution MRI is readily possible at NHMFL, and battery MRI should provide immense insights in this field.

Acknowledgements

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References

[1] Chandrashekar, S., *et al.*, Nature Materials, **11**, 311-315 (2012).