Lithium NMR for Li-Air Batteries

S. Chandrashekar (NHMFL); A. Shellikeri, J. Zheng (FAMU-FSU, Chemical and Biomedical Engineering); W.W. Brey, P. Gor'kov (NHMFL)

Introduction

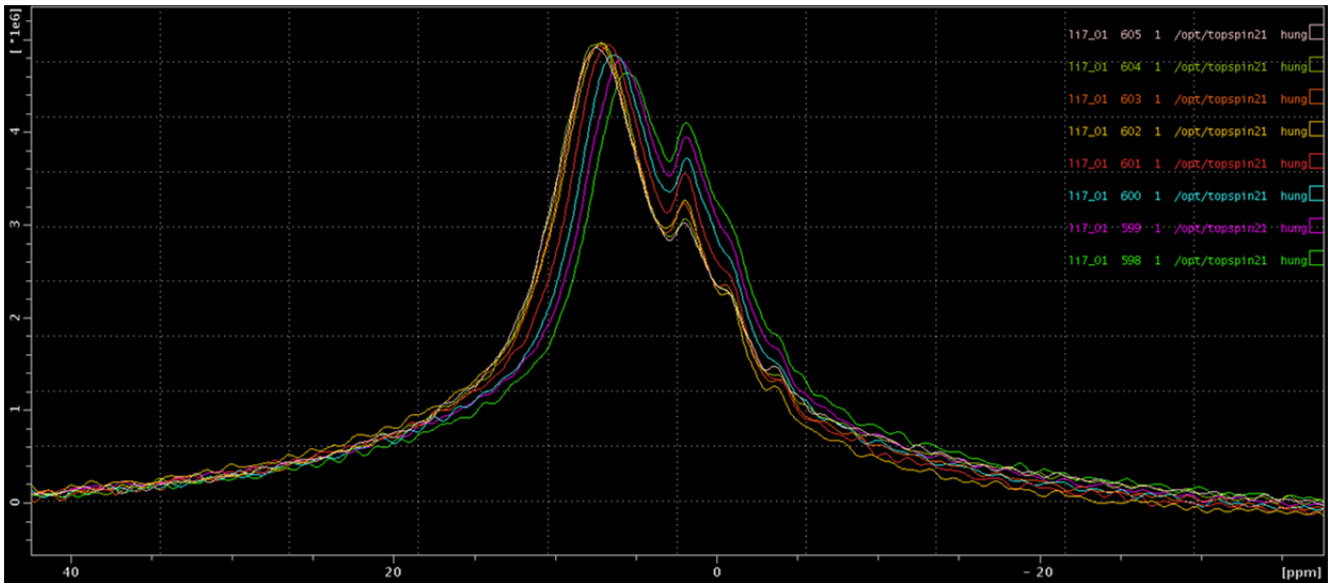
Li-Air batteries (LiAB's) (1,2) are temptingly attractive because of the potentially high energy density that is locked up in them --- more than 10 x that of Lithium ion batteries (LiBs). In practice LiAB's fall far short of this alluring promise. One of the main sources of this disappointment is the limited (specific) capacity of the porous carbon air-cathode electrode. In turn, the specific capacity is limited by many underlying factors, chief among them being the electrode thickness and the discharge current density. They are also affected by other serious afflictions such as extremely low power, poor cyclability and rapid deterioration due to moisture exposure. Obviously, overcoming even some of the obstacles offers tantalizing possibilities for the future! Teaming up w/ Prof. Zheng and his graduate student Mr. Shellikeri, with invaluable assist from the radio frequency laboratory (Dr. Brey and Mr. Gorkov), we have undertaken the studies of the LiAB's by NMR at NHMFL/FSU.

Experimental

We are carrying out *in situ* 7Li NMR studies on LiAB's at NHMFL/FSU facilities, under a systematic variation of the problematic factors.

Results and Discussion

A set of 7Li NMR spectra taken during a typical charge-discharge cycle is shown in the figure below. The



series of spectra display the electrolyte region. Comparison of these cycles under varying conditions of moisture, electrolyte type, electrode composition and geometry will offer clues as to how to improve the performance of LiAB's or conversely how to inhibit the air-electrode 'poisoning' (by examining all regions corresponding to other battery components such as cathode and anode electrodes as well).

Acknowledgements

Funding from Army CERDEC and the National Science Foundation/Future Renewable Electric Energy Delivery and Management (FAMU) is gratefully acknowledged.

References

[1] Zhang, G.Q., *et al.*, J. Electrochem. Soc., **159**, A310 (2012).
[2] Andrei, A.P., *et al.*, J. Electrochem. Soc., **159**, A770 (2012).