^{7}Li MAS-NMR Studies of Electrode Materials for Advanced Lithium Rechargeable Batteries

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In the search for suitable replacements for Ni- and Co-based electrode materials, manganese oxides have become a favored low-cost alternative. However, they tend to suffer from unacceptable capacity fade. A great deal of effort has been expended attempting to elucidate the mechanisms of this capacity fade and find stable forms of manganese oxide. This work furthers our understanding of failure mechanisms by utilizing nuclear magnetic resonance (NMR) spectroscopy to diagnose degradation processes in various baseline and novel lithium rechargeable battery chemistries.

NMR spectroscopy offers a very sensitive probe of the local magnetic field at the lithium nucleus, which depends greatly on the local atomic and electronic environment. This technique allows direct, quantitative observation of the lithium in the bulk of the material, as opposed to many other spectroscopic techniques which are limited to surface studies or observation of heavier elements. We are thus able to use NMR to elucidate features of the atomic and electronic structure of electrode materials and detect small changes in the structure accompanying electrochemical cycling.

In this work, we compare NMR spectroscopic results for electrode materials before and after electrochemical testing. Various chemistries are studied, including cobalt oxides, aluminum-substituted manganese oxide spinels, and tunnel-structure manganese oxides.

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