Electrochemical and Structural Characteristics of Perovskite-Like Electrode Materials

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Many of the current metal oxide electrode materials employed in lithium ion batteries, such as various Li-Mn-O, Li-Co-O and Li-V-O, exhibit extremely poor electronic conduction, which in turn limits their usable capacity in battery applications.[1] In order to overcome this problem, researchers typically add 10-20 wt % graphite to the various metal oxides in order to improve their conductivity.[2] Unfortunately, this results in a significant loss of Li capacity and other problems arising from secondary reactions between the Li ion and the graphite. In order to address this problem, simple perovskites or perovskite-like derivatives using Mn-O as the metal oxide of interest were prepared. These types of compounds have the advantage of high electrical conductivity that should not significantly vary as Li is intercalated and deintercalated.[3-5]

These oxide powders were prepared by heat firing of the metal oxide and the carbonates of interest, and the single-phase nature of the products were confirmed by X-ray powder diffraction. The powders were finely ground and combined with 10% PolyVinylidenediFluoroHexaFluoroPropene (PVdF-HFP) to form polymer composite cathodes in battery test cells with metallic lithium as the anode. Two types of cells were prepared, either a simple liquid battery cell using a lithium containing ionic liquid as the electrolyte or a solid state battery using an ionic liquid/polymer gel composite electrolyte. Initial results indicate that these electrode materials exhibited high charge-discharge efficiencies for over 200 cycles, with a discharge plateau near 4 volts for the compounds investigated (Figure 1). Furthermore, minimal voltage drop between charging and discharging is observed even though no conductive additive such as graphite was added to the polymer composite electrode. Finally, X-ray analysis of the electrodes failed to show any structural change in the unintercalated material after 200 cycles.

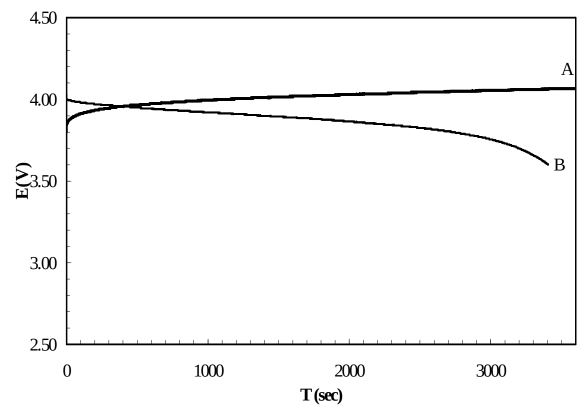

Figure 1. Charge (A) and Discharge (B) at 50 μA/cm^2 for an $Li_wA_xMn_yO_z$ Phase.

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