The study of thin film high–voltage Li-ion cathodes to reveal surface reactions and coating performance

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The performance of high-voltage lithium intercalation cathodes are limited because of reactions with the standard $LiPF_6$ carbonate electrolytes and possibly changes in the crystalline lattice when charged to voltages above about 4.3V versus lithium. By using thin films of the cathode materials, prepared by sputter deposition processing, it becomes feasible to identify and study reaction and degradation processes that are specific to the cathode compound. Further, the performance of various protective coatings can be investigated with good control and variation of the coating thickness and coverage at the interface.

Results will be presented for thin film cathodes of $LiCoO_2$ [1] and $LiMn_{1.5}Ni_{0.5}O_4$ [2] cathodes prepared as thin films which were cycled at room and elevated temperatures. The cathode films are protected with Lipon solid electrolyte coatings, ranging from sub-1nm to several hundred nanometer thickness. The reaction products upon cycling to high voltage are investigated by surface and bulk chemical analysis and x-ray diffraction. Electrochemically, we report careful analysis of the coulombic efficiency, irreversible capacity loss, differential capacity and interfacial impedance. These results provide evidence to sort through the list of possible degradation processes for these cathodes [3] and identify promising routes toward enhanced stability and cycle life.

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References:

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