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POS-18 Study of Al2O3 Coated Positive Electrode Materials

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Lithium Ion Batteries are widely used in a large variety of consumer products. With the rise in use in electric vehicles, increasing the energy density of LIBs is a priority. One way of accomplishing this is to increase the charge cutoff potential. However, this results in significant deterioration of the LIBs caused by side reactions between the electrolyte and the electrode. A possible solution to this is to use a coating to protect the positive electrode material. Al2O3 is currently being studied as a possible protective coating.
The Al2O3 is deposited through atomic layer deposition, which creates a thinner more even coating than the alternative wet-chemistry method. Two thicknesses of Al2O3 coatings are being investigated on two different types of positive electrode material, Lithium Nickel Manganese Cobalt Oxide (NMC) and Lithium Cobalt Aluminum Oxide (NCA). Samples from each material and coating type are heat treated to different temperatures ranging from 400˚C to 900˚C. To study the effects of the heat treatment temperature on the Al2O3 coating the samples underwent a range of different types of characterization testing. Scanning electron microscopy (SEM), x-ray photoelectron spectroscopy (XPS), x-ray absorption spectroscopy (XAS) and aluminum solid state nuclear magnetic resonance (Al NMR) have been used to study the heat-treated samples.
Results of the Al NMR on the thick coated NMC series suggests diffusion of the Al2O3 coating into the NMC begins with 400˚C heat treatment. XPS results differ from this, suggesting that diffusion begins at 600˚C for the thin coated material and 700˚C for the thick coated material. This suggests that the Al2O3 coating is thicker than the XPS measurement depth and the initial diffusion from the coating isn't visible to XPS while it is to NMR. As the heat treatment temperature increases, so does the diffusion of the Al2O3 layer into the NMC until the layer is reduced enough that the underlying NMC becomes visible to XPS measurement.
All electrode material powder samples were used to form electrodes and coin cell batteries were made from these for thorough electrochemical testing to evaluate the high voltage performance of the various coatings and heat treatment temperatures.

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