The effect of Self-induced surface modification of $LiCoO_2$ Cathode for High Voltage lithium ion batteries

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Interest in environmentally friendly electric vehicles is increasing due to frequent fluctuations in oil prices, environmental pollution, and diesel gates. However, when the currently used lithium ion battery is applied to an electric vehicle (EV), since the driving mileage after charging is relatively short, the use of electric cars is limited. Moreover, as the importance of sustainable energy sources increases, the efficient supply of energy during the day and at night becomes important so energy storage system (ESS) is emphasized. In order to use EV and ESS in real life, it is essential to increase the energy density of Lithium ion battery (LIB).

$LiCoO_2$, widely used as a cathode material, has a layer structure with relatively high potential and good rate capability. But, when $LiCoO_2$ is charged above 4.2 V (*vs.* Li/Li^+), which means that more than half of the Li ions in the structure are extracted, it undergoes an irreversible phase transition from hexagonal to monoclinic. Despite this fact, $LiCoO_2$ should be charged above 4.2 V (*vs.* Li/Li^+) in order to increase the energy density. Increasing the voltage to more than 4.2 V causes not only the phase transition problems due to the structural instability but also the electrolyte decompositions. As result, the discharge capacity rapidly decreases during the cycle.

In this presentation, we introduce a self-induced surface modification that does not require the cost-consuming coating precursors. The surface of $LiCoO_2$ is finely controlled via using a surface ion exchanging in the distilled water by a simple stirring without coating agent. The surface change of $LiCoO_2$ is analyzed by using XPS during the coating process, the coated surface is systematically analyzed using XRD, SEM, and TEM. The thickness of coating layer and coating materials can be controllable depending on the temperature of the heat treatment. When the heat treatment temperature is high, a thick inactive passivation layer is formed on the surface of $LiCoO_2$, which hinders the surface migration of Li ion transport and the electron conduction as well, thereby deteriorating cycle performance. On the other hand, samples annealed at low temperatures have a thin optimal coating layer, which improves cycleability by inhibiting electrolytic decomposition reaction during the cycle