



**Development of $\text{Li}_{1/3} \text{Ni}_{1/3} \text{Mn}_{1/3} \text{Co}_{1/3-x} \text{M}_x \text{O}_2$
Cathodes for Li-ion Battery**

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Abstract

Li-ion batteries are widely used in portable electronic industry, and have been considered for large scale applications such as electric or hybrid electric vehicles. Today the rapid development in electronics industry needs better batteries with higher energy storage, lower capacity decay, lighter weight and low cost. The high cost of the LIB is mainly due to the high cost of cathode materials. This study is mainly focused on the electrochemical performance of a $\text{Li}_{1/3} \text{Ni}_{1/3} \text{Mn}_{1/3} \text{Co}_{1/3-x} \text{M}_x \text{O}_2$ type cathode material.

$\text{Li}_{1/3} \text{Ni}_{1/3} \text{Mn}_{1/3} \text{Co}_{1/3-x} \text{M}_x \text{O}_2$ powder was successfully synthesized by employing the wet chemical powder preparation method: Glycine-nitrate process. The powder was calcinated at 650°C for two hours in air and using that powder pellets were prepared by uniaxial cold pressing technique. Then the green pellets were sintered in a furnace at 1000°C for two hours in static air. Before measure the electrical conductivity the pellets were gold pasted and heat treated at 730°C for one hour to make the better contact with Pt electrodes. The electrical conductivity of sintered pellets was measured by DC four-probe technique.

Flexible electrodes were fabricated for selected materials via tape casting. Tape casting was performed employing the doctor-blade technique. In this process, oxide powder was mixed with polyvinylidene fluoride (PVDF) binder and synthetic graphite in proportions 1: 0.25: 0.10 by weight. Those proportions were mix and blend with propylene carbonate (PC) corresponding to 40% of active material weight and dissolved with acetone. Slurry was stirred in magnetic stirrer and poured in to manual tape caster. The electrical conductivity of the prepared electrodes was measured by van der Pauw technique.

Then the electrical conductivity of selected best materials was enhanced by introducing synthetic graphite and Sri Lankan natural graphite as a conductivity enhancer.

This study shows that the possibility of using $\text{Li}_{1/3} \text{Ni}_{1/3} \text{Mn}_{1/3} \text{Co}_{1/3-x} \text{M}_x \text{O}_2$ type materials for LIB cathode. According to the observed data $\text{Li}_{1/3} \text{Ni}_{1/3} \text{Mn}_{1/3} \text{Co}_{1/3-x} \text{Mg}_{0.22} \text{O}_2$ and $\text{Li}_{1/3} \text{Ni}_{1/3} \text{Mn}_{1/3} \text{Co}_{1/3-x} \text{Zn}_{0.11} \text{O}_2$ materials got the most sufficient conductivity values that suitable for cathode. As a conductivity enhancer for cathode fabrication Sri Lankan natural graphite also can be used instead of synthetic graphite.