# UNIVERSITI TEKNOLOGI MARA

# SYNTHESIS AND ELECTROCHEMICAL PERFORMANCE OF SOLID SOLUTION OF LAYERED NANOSTRUCTURED $LiCo_{1-x}Ni_xO_2$ ($x$ = 0.0, 0.1, …, 0.9)

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of the requirements for the degree of
**Master of Science**

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# AUTHOR'S DECLARATION

I declare that work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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# ABSTRACT

Layered compounds are being investigated extensively due to their high theoretical specific capacities and relatively good cyclability. Lithium cobalt oxide ($LiCoO_2$) is an excellent cathode material but expensive and not abundant in nature. $LiNiO_2$, however, is unstable and do not exhibit good electrochemical properties. Substitution of nickel with cobalt may minimize the cobalt content and may reduce production cost. In this work, layered $LiCo_{1-x}Ni_xO_2$ ($x$ = 0.0. 0.1, ....., 0.9) *via* a novel self-propagating combustion synthesis and its electrochemical properties are investigated. Simultaneous Thermogravimetric Analysis (STA), X-Ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM), Energy Dispersive X-Ray Spectroscopy and High Resolution Transmission Electron Microscopy (HRTEM) were used to characterize all the materials. The characterization of all samples shows pure and single phase layered hexagonal structured materials obtained at 700 °C for 24 h with a polyhedral like morphology. The EDX results give the atomic percent for each sample and agreeable to calculated synthesized values. From cyclic voltammetry, the maximum voltage can reached up to 5.0 V and minimum voltage is 2.3 V. The $LiCo_{1-x}Ni_xO_2$ materials show good promise as cathode materials. The material $LiCo_{0.6}Ni_{0.4}O_2$ has the best specific capacity of 165 mAh/g in the first cycle. The five materials of $LiCo_{1-x}Ni_xO_2$ ($x$ = 0.3, 0.4, 0.5, 0.6, 0.7) exhibit high specific capacities but their energy densities are a little lower than that of $LiCoO_2$ due to the slightly slopping discharge plateaus of the materials.

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