

CELEBRATING
COMMERCIALISATION
YEAR 2014

iiindex 2014

AN INTERNATIONAL EXPOSITION ON RESEARCH AND INNOVATION

invention
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exposition 2014

INNOVATEUR
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2014

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UNIVERSITI TEKNOLOGI MARA
MALAYSIA

*Bridging
the valley of death :
advancing the
commercialisation
of research*

RESEARCH BOOK

iiindex2014

AN INTERNATIONAL EXPOSITION ON RESEARCH AND INNOVATION

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FOREWORD

The Honourable Minister of Science, Technology and Innovation (MOSTI) has launched 2014 as Malaysia Commercialisation Year 2014 (MCY2014) with the theme Science Technology and Innovation (STI) for Wealth Creation. In line with this theme, Invention, Innovation, Design & Exposition 2014 (iidex2014) is an annual exposition organized by UiTM and is the ultimate platform to highlight and commercialise new inventions and innovations. Researchers and inventors will exhibit their products which cater to the needs and wants of the community and the country.

The iidex2014 creates a new dimension by fusing two competitive concepts, a competition among innovative products and a competition to invite Innovateur Wannabes to perform live pitching of their products to the audience. The iidex2014 focuses on comprehensive commercialization and creating opportunities for entrepreneurs to carry out R&D as well as to provide avenue to commercialise their products. Through expositions such as iidex2014, MOSTI hopes to inculcate the culture of commercialisation of new technology designed and created by Malaysians.

I wish to congratulate all the participants of the iidex2014 and this is the opportunity for all researchers to show their ideas and exhibits their products and creativity. Apart from showcasing their products, innovators will have the opportunity to provide a window to the industry for business matching during the exposition.

Tan Sri Dato' Sri Sallehuddin Mohamed
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COBALT POOR AND RICH LIXNi1-YCOYO2 LAYERED MATERIALS FOR LI-ION BATTERY APPLICATION

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Layered compounds are being investigated extensively due to their high theoretical specific capacities and relatively good recycling ability. The electrochemical performance of a layered cathode material depends, to some extent, on the lattice parameters and structural stability of the crystal framework as well as, to a large extent, on the cation ordering of the compounds. Lithium cobalt oxide (LiCoO₂) is an excellent cathode material but expensive, toxicity and not abundant in nature. Therefore, it is logical to produce materials with less Co content for commercial application. LiNiO₂ has the advantage of being cheaper. However, it is unstable and does not exhibit good electrochemical properties. Substitution of Co with Ni may improve the structural stability of LixNi1-yCoyO₂ system and may reduce production cost due to the least of Co content. Many groups of researchers have attempted to synthesize some stoichiometries of LixNi1-yCoyO₂, but their XRD results show the presence of impurities. Other researchers have produced hexagonal structure but with poor cation ordering with high (104) peaks relative to the (003) peak. In this work, layered LixNi1-yCoyO₂ (x= 1.0, 1.05, 1.1; y= 0.0, 0.1, ..., 0.5) via a novel self-propagating combustion synthesis and its electrochemical properties are investigated. The most obvious advantage of using this combustion route is the ease of the method and speed of the reaction which is over in a few seconds. The precursors are already in the dry form, and, subsequently, the thermal annealing can be done directly without further drying or precalcination process. Therefore, the synthesis method has the advantage of producing homogenous materials with the resulting final products free from impurities, even for the Ni-rich stoichiometries. Simultaneous Thermogravimetric Analysis (STA), X-Ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive X-Ray Spectroscopy were used to characterize all the materials. The characterization of all samples shows pure and single phase layered hexagonal structured materials obtained at 700 degree celcius for 24 h, 48 h and 72 h with a polyhedral like morphology. This means that the Ni-ions have been successfully substituted in the LiCoO₂ structure. It can be clearly observed that all of the fingerprint peaks, namely, (003), (101), (006), (012), (104), (018), and (110) are easily identifiable in all of the XRD patterns. All the diffraction peaks can be indexed with alfa-NaFeO₂-type structure based on the hexagonal crystal system with R-3m space group. They are isostructural with LiNiO₂ and LiCoO₂ phases as compared with the XRD patterns in the ICDD database. The EDX results give 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 LixNi1-yCoyO₂ materilas show good promise as cathode materials. The best performance of cathode materials are LiNi_{0.5}Co_{0.5}O₂ with the specific capacity of 158.2 mAh/g, Li_{1.05}Ni_{0.6}Co_{0.4}O₂ with the specific capacity of 155.3 mAh/g, Li_{1.05}Ni_{0.7}Co_{0.3}O₂ with the specific capacity of 148.1 mAh/g, Li_{1.1}Ni_{0.6}Co_{0.4}O₂ with the specific capacity of 145.7 mAh/g, LiNi_{0.7}Co_{0.3}O₂ with the specific capacity of the 144.4 mAh/g, Li_{1.1}Ni_{0.7}Co_{0.3}O₂ and Li_{1.1}Ni_{0.5}Co_{0.5}O₂ with the specific capacity of 142.8 mAh/g.