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Synthesis, characterisation and electrochemical intercalation kinetics of nanostructured aluminium-doped Li $[Li_{0.2}Mn_{0.54}Ni_{0.13}Co_{0.13}]$ O_2 cathode material for lithium ion battery

Charl J. Jafta[a, b], Kenneth I. Ozoemena[a, c, 1], Mkhulu K. Mathe[a], Wiets D. Roos[d]

[a] *Energy Materials, Materials Science and Manufacturing, CSIR, Pretoria, South Africa*

[b] *Department of Physics, University of Pretoria, Pretoria 0002, South Africa*

[c] *Department of Chemistry, University of Pretoria, Pretoria 0002, South Africa*

[d] *Department of Physics, University of Free State, Bloemfontein, South Africa*

1 Corresponding author: Email address: kozoemena@csir.co.za

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Abstract

The electrochemistry and intercalation kinetics of nanostructured Li[Li0.2Mn0.54Ni0.13Co0.13]O2 (LMNC) and its aluminium-doped counterpart Li[Li0.2Mn0.52Ni0.13Co0.13Al0.02]O2 (LMNCA) are reported. FESEM and AFM images showed the LMNCA to be slightly higher in size (50–200 nm) than the LMNC (50–100 nm). Current-sensing AFM showed the LMNCA to be more conductive than the LMNC. XRD data showed the LMNCA to be more ordered and crystalline than the LMNC. The initial discharge capacity of the LMNCA is lower than that of the LMNC, but LMNCA shows a better stability with cycling and a better discharge capacity. The EIS results showed some variation in surface film resistance (Rf) and lithium intercalation/de-intercalation resistance (Rct) as a function of applied voltage. The enhanced conductivity of the LMNCA has been related to the higher amount of the Mn3+ cation in the lattice, aided by the increased c-lattice that enhances the diffusivity of Li during the electrochemical cycling. LMNCA showed enhanced diffusion coefficient and electron transfer rate constant compared to the LMNC. The study provides further opportunities for improvement in the electrochemical performance of the LMNC by optimizing the synthesis conditions.