Journal of Alloys and Compounds

High rate and stable capacity performance of 2D LiMn1.5Ni0.5O4 nanoplates cathode with ultra-long cycle stability

N. Palaniyandy[a,*], M.V. Reddy[b], K. Zaghi[bc], M.A. Kebede[a], K. Rajua, R.M. Modibedi[a],

M.K. Mathe[a], K.P. Abhilashd, S. Balamuralikrishnan[e]

[a] Energy Centre, Council for Scientific & Industrial Research (CSIR), Pretoria 0001, South Africa

[b] Nouveau Monde Graphite, 481 Rue Brassard, Saint-Michel-de-Saints, QC J0K 3B0, Canada

[c] Department of Mining and Materials Engineering, McGill University, Wong Building, 3610, Montreal, QC H3A OC5, Canada

[d] Department of Inorganic Chemistry, University of Chemistry and Technology Prague, 166 26 Prague 6, Czech Republic

[e] Department of Physics (DDE), Annamalai University, Annamalai Nagar, 608002, India

https://www.sciencedirect.com/science/article/pii/S0925838822002602?via%3Dihub

Abstract

Typically, the high electrochemical performance of cathode materials is achieved by fine-tuning the surface morphology and particle size of the nano-electrode materials. Two-dimensional (2D) nanomaterials like nanoplates show astounding advantages of high surface area and shorter diffusion path-length, inducing improved Li-ion kinetics compared to bulk and 1D cathodes. This study reports the fabrication of 2Dnanoplates of LiMn1.5Ni0.5O4 via the solid-state method using a-MnO2 nanorods prepared from EMD, as a highly stable and long-cycle life cathode for lithium-ion battery (LIBs) applications. The fabricated 2DLMNO nanoplates delivered an exceptional specific capacity of 88 mAh g-1 at a high current rate of 1 C and 98% retention of its initial capacity upon 1000 consecutive cycles. The nanoplates rendered a specific capacity of 77 mAh g-1 even at a high current rate of 7 C. The aligned LMNO stacked nanoplates with exposed {111} facets, and large Mn4+ concentration revealed high lithium-ion coefficient, decreased Mn dissolution, and high interfacial stability, which resulted in enhanced cycle stability and rate capability. The remarkable electrochemical performance of the LMNO cathode was attributed to its unique 2D-nanoplates structure, which is favourable for accommodating volume changes during the repeated insertion and de-insertion of lithium ions.