Journal of The Electrochemical Society

Manganese-based metal organic framework from spent Li-Ion batteries and its electrochemical performance as anode material in Li-ion battery

Khavharendwe Rambau[1,2] Nicholas M. Musyoka[1,z] Nithyadharseni Palaniyandy[3] and Ncholu Manyala[2,z]

[1] HySA Infrastructure Centre of Competence, Centre for Nanostructures and Advanced Materials (CeNAM), Chemicals
Cluster, Council for Scientific and Industrial Research (CSIR), Pretoria 0001, South Africa
[2] Department of Physics, Institute of Applied Materials, SARCHi Chair in Carbon Technology and Materials, University of
Pretoria, Pretoria 0002, South Africa
[3] Energy Centre, Smart Places Cluster, Council for Scientific and Industrial Research (CSIR), Pretoria 0001, South Africa

https://iopscience.iop.org/article/10.1149/1945-7111/abd285/meta

Abstract

Herein, we report a method of recycling spent lithium-ion batteries (LIBs) cathode materials by utilizing them as a metal feedstock for the synthesis of Mn-based metal-organic frameworks (Mn-MOF). Spent cathodes were converted to manganese salts using acids (HCl and H2SO4) and reacted with commercial benzene-1,4-dicarboxylic acid (H2BDC), as an organic linker. The LIB-derived metal salts were compared to commercial available MnCl2 salt in the formation of Mn-MOFs. Mn-MOFs from spent LIBs (MOF(Cl2) and Mn-MOF(SO4)) exhibited similar morphological, structural and textural properties when compared to that obtained from commercial MnCl2 salt. HCl obtained MOF (Mn-MOF(Cl2)) was analysed for electrochemical properties due to its superior structural properties. It achieved coulombic efficiency of approximately 99% and discharge capacity of 1355 mAh g-1 as compared to Mn-MOF obtained using commercial salt (Mn-MOF(Com)) with a discharge capacity of 772.55 mAh g-1 at 100 cycles. The developed LIBs recycling strategy has the potential for contributing to existing LIBs recycling strategies and as well to the circular economy.