Appl. Phys. A (2015) 121:51–57
DOI 10.1007/s00339-015-9311-0

Solution-combustion synthesized aluminium-doped spinel ($LiAl_xMn_{2-x}O_4$) as a high-performance lithium-ion battery cathode material

Mesfin A. Kebede[1] Maje J. Phasha[2] Niki Kunjuzwa[1,3] Mkhulu K. Mathe[1] Kenneth I. Ozoemena[1,3]

Abstract

High-performing $LiAl_xMn_{2-x}O_4$ (x = 0, 0.125, 0.25, 0.375, and 0.5) spinel cathode materials for lithium-ion battery were developed using a solution combustion method. The as-synthesized cathode materials have spinel cubic structure of $LiMn_2O_4$ without any impurity peak and accompanied with peak shift as doping with aluminium. $LiAl_{0.375}Mn_{1.625}O_4$ (first cycle capacity = 113.1 mAh g^{-1}) retains 85 % (96.2 mAh g^{-1}), while pristine $LiMn_2O_4$ electrode (first cycle capacity = 135.8 mAh g^{-1}) fades quickly and retains only 54 % (73.9 mAh g^{-1}) after 50 cycles. The electrochemical performance of all the cathode samples prepared using the SCM is comparable to those reported for Al-doped $LiMn_2O_4$ spinel cathode materials. The experimental lattice parameter of $LiAl_xMn_{2-x}O_4$ was validated by ab initio calculations and correlated with the first cycle capacity of materials. The variation in lattice parameter as a result of Al doping greatly enhanced the cyclability of discharge capacity of the $LiMn_2O_4$ spinel.