

## Properties of nano-structured lithium cobaltates grown from succinate precursors

N. Amdouni<sup>a,b</sup>, S. Selladurai<sup>c</sup>, F. Soulette<sup>a</sup> and C. Julien<sup>a</sup>

<sup>a</sup>LMDH, UMR 7603, Université Pierre et Marie Curie  
4 place Jussieu, 75252 Paris cedex 05, France

<sup>b</sup>LCM, Université de Tunis El Manar, Campus  
Universitaire, 2092 El Manar II, Tunisia

<sup>c</sup>Solid State Ionics Laboratory, MIT, Anna University  
Chennai 600044, India

The development of rechargeable Li-ion batteries using intercalation compounds depends critically on advances in electrode materials. Progress has already been made to overcome the capacity fading by doping cobaltate networks with several cations.

The  $\text{LiMe}_y\text{Co}_{1-y}\text{O}_2$  (Me=Ni, Cr, Al) materials were synthesized by the wet-chemistry technique using aqueous solutions of metal acetates and succinic acid as a chelating agent. Samples included:  $\text{LiCo}_{0.7}\text{Ni}_{0.3}\text{O}_2$ ,  $\text{LiCo}_{0.7}\text{Cr}_{0.3}\text{O}_2$ ,  $\text{LiCo}_{0.7}\text{Al}_{0.3}\text{O}_2$  and  $\text{LiCoO}_2$ . The elemental analysis of products was characterized by ICP, their structural properties were studied by X-ray powder diffractometry and FTIR spectroscopy. The morphologies of powders were examined by SEM.

Fig. 1 displays the XRD patterns of  $\text{LiCo}_{0.7}\text{Me}_{0.3}\text{O}_2$  (Me=Ni, Cr, Al) oxides. These data show impurity-free compounds crystallizing in the single phase with the rhombohedral  $\alpha\text{-NaFeO}_2$ -type structure (R-3m S.G.).

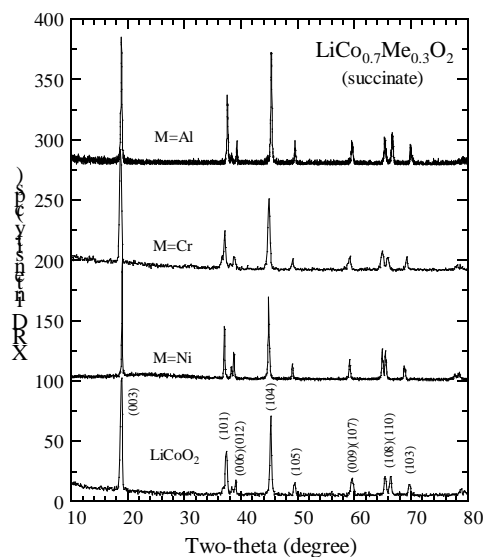


FIG. 1.

Upon Me substitution, the (006) and (108) peaks shift toward lower  $2\theta$  angles, resulting in a wider split of doublets corresponding to the (006)(102) and (108)(110) Bragg lines compared with the native oxide  $\text{LiCoO}_2$ . The replacement of Co by Me atoms results in slight a-axis shrink and c-axis enlargement. It is interesting to note that the lattice parameter variations are very similar for the different dopants.

SEM studies reveal the nano-structured morphology of the powders. The influence of Al doping on particle size and morphologies has been clearly evidenced. FTIR absorption spectra indicate the slight modification in the local structure related to the short-range environment of oxygen coordination around the cations in oxide lattices.

To compare the retention capacity of  $\text{LiMe}_y\text{Co}_{1-y}\text{O}_2$  cells, the electrochemical characteristics of the 4-volt oxides were evaluated as positive electrode materials in cells using Li-metal as negative electrode. The layered lattices of  $\text{LiCo}_{0.7}\text{Ni}_{0.3}\text{O}_2$ ,  $\text{LiCo}_{0.7}\text{Al}_{0.3}\text{O}_2$ , and  $\text{LiCo}_{0.7}\text{Cr}_{0.3}\text{O}_2$  resemble to that of  $\text{LiCoO}_2$ , while the charge-discharge profiles show the disappearance of the

first voltage plateau at ca. 3.85 V due to the absence of the semiconductor-metal transition in doped materials.

The trends of cycling for the doped materials presented in Fig. 2 show long life electrochemical behavior obtained with Ni and Al doped oxides. Otherwise, the cell using the  $\text{LiCo}_{0.7}\text{Cr}_{0.3}\text{O}_2$  oxide does not perform well. No reason could be given for such a trend.

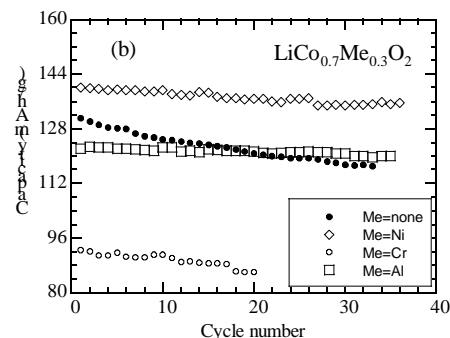


FIG. 2.