Solubility and electrochemical studies of $LiFeO_2$–$LiCoO_2$–NiO materials for the MCFC cathode application

Armelle Ringuedé [a,*], Athula Wijayasinghe [b,d], Valérie Albin [a], Carina Lagergren [c], Michel Cassir [a], Bill Bergman [b]

[a] *Laboratoire d'Electrochimie et de Chimie Analytique, UMR 7575 CNRS-ENSCP, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France*
[b] *Department of Materials Science and Engineering, KTH, Royal Institute of Technology, Sweden*
[c] *Department of Chemical Engineering and Technology, KTH, Royal Institute of Technology, Sweden*
[d] *Institute of Fundamental Studies, Kandy, Sri Lanka*
Available online 12 June 2006

Abstract

The dissolution of the state-of-the-art lithiated NiO is still considered as one of the main obstacles to the commercialisation of the molten carbonate fuel cell (MCFC). Development of alternative cathode materials has been considered as a main strategy for solving this problem. Ternary compositions of $LiFeO_2$, $LiCoO_2$ and NiO are expected to decrease the cathode solubility while ensuring a good electrical conductivity and electrochemical activity towards the oxygen reduction.

In this work, new material compositions in the $LiFeO_2$–$LiCoO_2$–NiO ternary system were synthesised using Pechini method and investigating their electrical conductivity by the DC four probe method. Then the influence of the cobalt content in the composition was determined in terms of AC impedance analysis and solubility measurements after 200 h of immersion in Li_2CO_3–Na_2CO_3 at 650 °C. The DC electrical conductivity study reveals the ability of improving the electrical conductivity, adequate for MCFC cathode application, by controlling the Co content of the composition. A special attention was given to the evolution of the open circuit potential as a function of time and to the impedance spectroscopy characterization related to microstructure modifications. Taking into account solubility, electrical conductivity, as well as electrochemical performance in the fuel cell, this study reveals the possibility of using $LiFeO_2$–$LiCoO_2$–NiO ternary materials for MCFC cathode.

Keywords: MCFC; Cathode; $LiFeO_2$–$LiCoO_2$–NiO ternary materials; Open circuit potential; Solubility; Impedance spectroscopy