

Technical University of Denmark



Defect structure, electronic conductivity and expansion properties of LaSrCoNiO₃

Hjalmarsson, Per; Søgaard, Martin; Mogensen, Mogens Bjerg

Publication date:
2009

Document Version
Early version, also known as pre-print

[Link back to DTU Orbit](#)

Citation (APA):
Hjalmarsson, P., Søgaard, M., & Mogensen, M. B. (2009). Defect structure, electronic conductivity and expansion properties of LaSrCoNiO₃. Abstract from American Ceramic Society conference, Dayton, .

DTU Library

Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Defect structure, electronic conductivity and expansion properties of $(\text{La}_{1-x}\text{Sr}_x)_s\text{Co}_{1-y}\text{Ni}_y\text{O}_{3-\delta}$

Per Hjalmarsson^{a,*} Martin Sjøgaard^a Mogens Mogensen^a

^a*Fuel Cells and Solid State Chemistry Department, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, P.O. 49, DK-4000 Roskilde, Denmark.*

Abstract

The perovskite LaCoO_3 was early recognized as a candidate material in SOFC-cathodes and the aliovalently substituted $\text{La}_x\text{Sr}_{1-x}\text{CoO}_3$ has shown promising electrochemical activity towards the oxygen reduction reaction. Ni-substitution in $\text{La}_x\text{Sr}_{1-x}\text{CoO}_3$ has been reported to increase both electronic and ionic conductivity as well as decrease the thermal expansion coefficient. These properties are considered highly important for materials to be exploited in SOFC.

This presentation reports on oxygen nonstoichiometry, electronic conductivity and lattice expansion of three compositions as function of T and P_{O_2} in the $(\text{La}_{1-x}\text{Sr}_x)_s\text{Co}_{1-y}\text{Ni}_y\text{O}_{3-\delta}$ materials system. The nonstoichiometry data were successfully fitted using the itinerant electron model which indicates the existence of delocalised electronic states. This was also reflected in the high electronic conductivities, above 1000 Scm^{-1} measured for all three compositions. The electronic conductivity was further shown to decrease linearly with the oxygen nonstoichiometry parameter, δ , indicating that the conductivity is dependent on p -type charge carrier concentration. Comparing calculated p -type mobilities with data reported in literature on $\text{La}_x\text{Sr}_{1-x}\text{CoO}_3$ indicated that Ni-substitution into $(\text{La}_{1-x}\text{Sr}_x)_s\text{CoO}_{3-\delta}$ increases the mobility. The electronic conductivity was also found to be dependent on intrinsic properties not related to strontium substitution. Based on calculated mobilities and literature data on related composition a conductivity model is hypothesized including a metallic like conductivity of the *extrinsic* p -type charge and a small polaron conductivity of the *intrinsic* charge. Lattice expansion as function of T and δ was successfully fitted using first and second order thermal and chemical expansion coefficients. Substituting 10 % Co with Ni in $(\text{La}_{0.6}\text{Sr}_{0.4})_{0.99}\text{CoO}_{3-\delta}$ was found to decrease the thermal expansion with about 25 %. The results are compared and discussed in the light of recent literature.

Key words: LSCN, conductivity, thermal expansion, chemical expansion, oxygen nonstoichiometry,

* Corresponding author. Tel:0045 4677 5759; Fax 0045 4677 5858
Email address: per.hjalmarsson@risoe.dk (Per Hjalmarsson).