

## 固態氧化物燃料電池之 $\text{La}_{0.9}\text{Ca}_{0.1}\text{Co}_{1-y}\text{Ni}_y\text{O}_{3-\delta}$ 陰極材料的 電特性和顯微結構研究

### Studies of Microstructures and Electrical Properties of $\text{La}_{0.9}\text{Ca}_{0.1}\text{Co}_{1-y}\text{Ni}_y\text{O}_{3-\delta}$ Cathode Material for SOFCs

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#### 摘 要

本實驗使用固態反應法，備製中溫型固態氧化物燃料電池(Intermediate Temperature Solid Oxide Fuel Cell, IT-SOFC)之陰極材料，成功的合成修飾過後之鏷鈣鎳鈷鈣鈦礦氧化物( $\text{La}_{0.9}\text{Ca}_{0.1}\text{Co}_{1-y}\text{Ni}_y\text{O}_{3-\delta}$ ,  $y = 0\sim 0.3$ )。此鈣鈦礦氧化物材料是經由  $1,400^\circ\text{C}$  之高溫環境下，燒結 6 小時而成型。藉由 X 光繞射分析、掃描式電子顯微鏡觀察與四點探針導電度量測等技術，分析此種類型的鈣鈦礦氧化物材料之顯微結構、導電與物理特性。本實驗結果發現，在不同的組成之下，所有樣本均呈現菱方晶鈣鈦礦結構。四點探針導電度測量則顯示出這些陶瓷材料具有與半導體相同性質之導電特性。當材料的成分為  $y = 0.1$  時，最高導電率可以達到  $750.3 \text{ S/cm}$ ，而其活化能為  $7.104 \text{ kJ/mole}$ ，由此資料可以了解，導電之載子主要為電洞與電子。

**關鍵詞：**固態氧化物燃料電池、固態反應法、陰極材料、四點探針導電度量測。

#### Abstract

Solid state reaction was adopted to produce the cathode material for intermediate temperature solid oxide fuel cell, and a modified oxide material, which is consisted of La, Ca, Co and Ni and presenting a lattice structure of perovskite, was successfully synthesized. The chemical formula is known as  $\text{La}_{0.9}\text{Ca}_{0.1}\text{Co}_{1-y}\text{Ni}_y\text{O}_{3-\delta}$ ,  $y = 0\sim 0.3$ , and this perovskite material was sintered at  $1,400^\circ\text{C}$  for 6 hours. The microstructure, conductivity and physical properties were analyzed by X-ray diffraction, scanning electron microscopy, and four-probe technique. The results of this experiment discovered that the lattice structure of this material is distorted rhombohedral perovskite no matter what the composition is in the range of  $y = 0\sim 0.3$ . Four-probe measurements had shown that these ceramics have the same conductive character as semiconductors do. When the composition reached  $y = 0.1$ , the highest conductivity was  $750.3 \text{ S/cm}$ , and its activation energy was  $7.104 \text{ kJ/mole}$ . With the knowledge from electrical measurements, it can be understood that the conductive carriers were mainly electrons and holes.

**Key words:** Solid oxide fuel cell, solid state reaction, cathode material and fourprobe technique.

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