

การสังเคราะห์  $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{M}_x\text{O}_3$  ( $\text{M} = \text{Ni}, \text{Cu}, \text{Al}$  และ  $\text{Mn}$ ) เป็นวัสดุแอโนดสำหรับเซลล์

เชื้อเพลิงแบบออกไซด์ของแข็ง

นางสาวนันทิวรรณ วิรัตน์นันท

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

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MATERIALS FOR SOLID OXIDE FUEL CELL

Miss Nantiwat Virattayanon

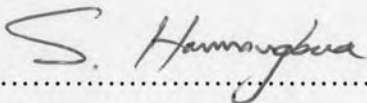
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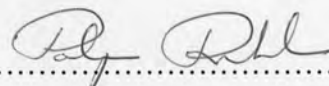
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By                       Miss Nantiwat Virattayanon  
Field of Study       Petrochemistry and Polymer Science  
Advisor               Assistant Professor Oravan Sanguanruang, Ph.D.  
Co-Avisor           Parichatr Vanalabhpatana, Ph.D.

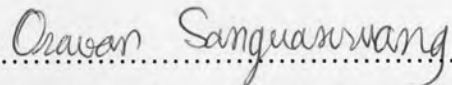
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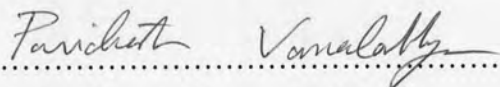
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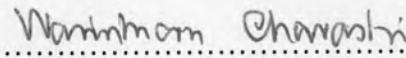
  
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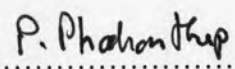
#### THESIS COMMITTEE

  
.....Chairman  
(Professor Pattarapan Prasassarakich, Ph.D.)

  
.....Advisor  
(Assistant Professor Oravan Sanguanruang, Ph.D.)

  
.....Co-Advisor  
(Parichatr Vanalabhpatana, Ph.D.)

  
.....Examiner  
(Assistant Professor Warinthorn Chavasiri, Ph.D.)

  
.....External Examiner  
(Associate Professor Preecha Phahonthep)

นันทิวรรณ วิรัตยานนท์ : การสังเคราะห์  $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{M}_x\text{O}_3$  ( $\text{M} = \text{Ni}, \text{Cu}, \text{Al}$  และ  $\text{Mn}$ ) เป็นวัสดุแอโนดสำหรับเซลล์เชื้อเพลิงแบบออกไซด์ของแข็ง (SYNTHESIS OF  $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{M}_x\text{O}_3$  ( $\text{M} = \text{Ni}, \text{Cu}, \text{Al}$  and  $\text{Mn}$ ) AS ANODE MATERIALS FOR SOLID OXIDE FUEL CELL) อ. ที่ปริกษาวิทยานิพนธ์หลัก: ผศ. ดร. อรวรรณ สงวนเรือง, อ.ที่ปริกษาวิทยานิพนธ์ร่วม: อ.ดร.ปาริฉัตร วนลาภพัฒนา, 77 หน้า

ศึกษาอิทธิพลของการเติมคอปเปอร์, นิกเกิล, อะลูมินัม และแมงกานีสที่ตำแหน่ง B ต่อโครงสร้างและสมบัติต่างๆของสารประกอบเพอโรฟสไกต์ออกไซด์  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  ที่สังเคราะห์ด้วยวิธีไฮดรอตระยุกต์ สารที่เติมคอปเปอร์, อะลูมินัม และแมงกานีส แสดงเฟสเดี่ยวที่มีโครงสร้างเป็นคิวบิกเพอโรฟสไกต์และไม่มีสารอื่นปนยกเว้นสารเติมด้วยนิกเกิล ซึ่งแสดงเฟสเดี่ยวที่มีโครงสร้างเป็นแบบเตตระโกนัล โลหะเติมที่ตำแหน่งเหล็กมีผลกระทบต่อขนาดผลึกของวัสดุ  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  การเพิ่มขึ้นของปริมาณคอปเปอร์, อะลูมินัม และแมงกานีสเป็นผลให้ขนาดผลึกลดลง ในทางตรงกันข้ามขนาดผลึกจะเพิ่มขึ้นเมื่อเพิ่มปริมาณนิกเกิลที่แทนที่เหล็ก สมบัติรีดักชันตรวจสอบโดยใช้เทคนิค Temperature-Programmed Reduction (TPR) โดยผลที่ได้แสดงว่ากระบวนการรีดักชันเพิ่มขึ้นด้วยการเติมโลหะที่ตำแหน่ง B ค่าการนำไฟฟ้าของสาร  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  ได้รับการปรับปรุงด้วยการเติมโลหะคอปเปอร์ และนิกเกิล โดยเฉพาะอย่างยิ่งการเติม 30% นิกเกิล เป็นปริมาณที่มีประสิทธิภาพสำหรับการนำไฟฟ้าของ  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  ที่อุณหภูมิ 750 องศาเซลเซียส  $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.7}\text{Ni}_{0.3}\text{O}_3$  แสดงค่าการนำไฟฟ้า (650.5 ซีเมนต์ต่อเซนติเมตร) สูงกว่า  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  (170 ซีเมนต์ต่อเซนติเมตร) ถึง 3.8 เท่า นอกจากนี้ค่าการขยายตัวทางความร้อนของการเติมโลหะนิกเกิลเพิ่มขึ้นเมื่อเพิ่มปริมาณนิกเกิล

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## 4972458623 : MAJOR PETROCHEMISTRY AND POLYMER SCIENCE  
 KEYWORDS: PEROVSKITE OXIDE/ ANODE MATERIAL/ ELECTRICAL  
 CONDUCTIVITY

NANTIWAT VIRATTAYANON: SYNTHESIS OF  $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{M}_x\text{O}_3$  (M = Ni, Cu, Al and Mn) AS ANODE MATERIALS FOR SOLID OXIDE FUEL CELL. ADVISOR: ASST. PROF. ORAVAN SANGUANRUANG, Ph.D., CO-ADVISOR: PARICHATR VANALABHPATANA, Ph.D., 77 pp.

The influence of Cu, Ni, Al and Mn doping at the B-site on the structure and properties of the perovskite oxide  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  was studied. These oxides were synthesized by the modified citrate method. The Cu, Al and Mn specimens showed homogeneous and single phase with cubic perovskite structure, except that Ni-doped specimens which showed single phase with tetragonal structure. The doped metals at the Fe site had significant effect on the crystallite size of  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  materials. The increase of doping amounts of Cu, Al and Mn caused a decrease in the crystallite size of  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  species. On the contrary, the crystallite size increased with the amount of Ni substituted at the Fe site. Reduction property was determined by Temperature-Programmed Reduction (TPR) technique. The result showed that the reduction process increased with the B site metal doping. The conductivity of  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  species was improved by Cu and Ni doping, especially 30% Ni doping that was the most effective quantity for enhancing the electrical conductivity of  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ . At 750°C, the conductivity of  $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.7}\text{Ni}_{0.3}\text{O}_3$  (650.5 S/cm) was about 3.8 times higher than that of undoped  $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$  (170 S/cm). In addition, thermal expansion coefficient of Ni-doped specimens increased with increasing Ni contents.

Field of Study: Petrochemistry and Polymer Science Student's Signature Nantawat Virattayanon  
 Academic Year: ..... 2008 ..... Advisor's Signature Oravan Sanguanruang  
 Co-Advisor's Signature Parichatr Vanalabhpata

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# CONTENTS

	<b>Page</b>
<b>ABSTRACT (THAI)</b> .....	iv
<b>ABSTRACT (ENGLISH)</b> .....	v
<b>ACKNOWLEDGEMENTS</b> .....	vi
<b>CONTENTS</b> .....	vii
<b>LIST OF TABLES</b> .....	xi
<b>LIST OF FIGURES</b> .....	xiii
<b>LIST OF ABBREVIATIONS</b> .....	xv
<b>CHAPTER I INTRODUCTION</b> .....	<b>1</b>
1.1 Background .....	1
1.2 Fuel cells .....	1
1.3 Solid Oxide Fuel Cells (SOFCs) .....	3
1.3.1 Cathode .....	5
1.3.2 Electrolyte .....	5
1.3.3 Anode .....	5
1.3.4 Interconnect .....	6
1.3.5 Compatibility of the materials system .....	6
1.3.6 Operation of SOFC .....	7
1.4 Perovskite .....	7
1.4.1 Structure .....	8
1.4.2 Properties of perovskite .....	9
1.4.3 Perovskite synthesis .....	14
1.5 Literature review .....	19
1.6 The objectives of the thesis .....	23
<b>CHAPTER II EXPERIMENTAL</b> .....	<b>24</b>
2.1 Chemicals .....	24
2.2 Synthesis of perovskite powder by modified citrate method .....	25
2.3 Perovskite disc preparation .....	26
2.4 The sintering of the Perovskite Oxide .....	26
2.5 Characterization techniques .....	28

	<b>Page</b>
2.5.1 X-ray diffractometry (XRD).....	28
2.5.2 Scanning electron microscopy (SEM).....	28
2.5.3 Density.....	28
2.5.4 Temperature-programmed reduction (TPR).....	28
2.5.5 Electrical conductivity measurement .....	29
2.4.6 Dilatometer.....	30
<b>CHAPTER III RESULTS AND DISCUSSIONS.....</b>	<b>31</b>
3.1 Synthesis of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{M}_x\text{O}_3$ (M= Cu, Ni, Al and Mn) (x= 0.1-0.4) by modified citrate method.....	31
3.2 Characterization of the synthesized compounds.....	31
3.2.1 X-ray diffraction (XRD).....	32
3.2.1.1 Phase formation of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ .....	32
3.2.1.2 Phase formation of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ (x=0.1 and 0.2).....	33
3.2.1.3 Phase formation of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ (x=0.1, 0.2 and 0.3).....	34
3.2.1.4 Phase formation of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ (x=0.1, 0.2, 0.3 and 0.4).....	36
3.2.1.5 Phase formation of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ (x=0.1 and 0.2).....	37
3.3.2 Scanning electron microscope (SEM) and density.....	39
3.3.2.1 The morphology of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ .....	39
3.3.2.2 The morphologies of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ (x=0.1 and 0.2).....	40
3.3.2.3 The morphologies of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ (x=0.1, 0.2 and 0.3).....	41
3.3.2.4 The morphologies of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ (x=0.1, 0.2, 0.3 and 0.4).....	42
3.3.2.5 The morphologies of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ (x=0.1 and 0.2).....	43



	<b>Page</b>
3.3.3 Temperature-Programmed reduction (TPR).....	44
3.3.3.1 Reducibility of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ .....	44
3.3.3.2 Reducibility of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ (x=0.1 and 0.2).....	45
3.3.3.3 Reducibility of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ (x=0.1, 0.2 and 0.3).....	46
3.3.3.4 Reducibility of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ (x=0.1, 0.2, 0.3 and 0.4).....	47
3.3.3.5 Reducibility of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ (x=0.1 and 0.2).....	48
3.3.4 Electrical conductivity measurement.....	49
3.3.4.1 Electrical conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ .....	49
3.3.4.2 Electrical conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ (x=0.1 and 0.2).....	51
3.3.4.3 Electrical conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ (x=0.1, 0.2 and 0.3).....	53
3.3.4.4 Electrical conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ (x=0.1, 0.2, 0.3 and 0.4).....	56
3.3.4.5 Electrical conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ (x=0.1 and 0.2).....	58
3.3.5 The thermal expansion coefficients.....	61
3.3.5.1 The thermal expansion coefficients of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ .....	61
3.3.5.2 The thermal expansion coefficients of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ (x=0.1 and 0.2).....	63
3.3.5.3 The thermal expansion coefficients of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ (x=0.1, 0.2 and 0.3).....	64
<b>CHAPTER IV CONCLUSION</b> .....	<b>66</b>
<b>REFERENCES</b> .....	<b>69</b>
<b>APPENDICES</b> .....	<b>74</b>
Appendix A.....	75
Appendix B.....	76

VITAE .....	77
-------------	----

## LIST OF TABLES

Table	Page
1.1 Types of fuel cells.....	2
2.1 Reagents for synthesis of perovskites.....	24
3.1 The lattice parameters and crystalline size of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ ( $x=0, 0.1$ and $0.2$ ) after calcined at $900\text{-}1000^\circ\text{C}$ for 6 hours.....	34
3.2 The Lattice parameter and crystalline size of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ ( $x=0, 0.1, 0.2$ and $0.3$ ) after calcined at $1000^\circ\text{C}$ for 6 hours.....	35
3.3 The lattice parameters and crystalline size of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ ( $x=0, 0.1, 0.2, 0.3$ and $0.4$ ) after calcined at $1000^\circ\text{C}$ for 6 hours.....	37
3.4 The lattice parameters crystalline size of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ ( $x=0.1$ and $0.2$ ) after calcined at $1000^\circ\text{C}$ for 6 hours.....	38
3.5 Density of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ discs when $x = 0.1$ and $0.2$ .....	40
3.6 Density of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ discs when $x = 0.1, 0.2$ and $0.3$ .....	41
3.7 Density of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ discs when $x = 0.1, 0.2, 0.3$ and $0.4$ .....	43
3.8 Density of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ discs when $x = 0.1, \text{ and } 0.2$ .....	43
3.9 The specific conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ ( $x=0.1$ and $0.2$ ).....	52
3.10 Activation energy of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ and $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ ( $x=0.1$ and $0.2$ ).....	53
3.11 The specific conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ ( $x=0.1, 0.2$ and $0.3$ ).....	54
3.12 Activation energy of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ and $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ ( $x=0.1, 0.2$ and $0.3$ ).....	55
3.13 The specific conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ ( $x=0.1, 0.2, 0.3$ and $0.4$ ).....	56
3.14 Activation energy of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ and $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Al}_x\text{O}_3$ ( $x=0.1, 0.2, 0.3$ and $0.4$ ).....	58
3.15 The specific conductivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ ( $x=0.1$ and $0.2$ ).....	59
3.16 Activation energy of $\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$ and $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Mn}_x\text{O}_3$ ( $x=0.1$ and $0.2$ ).....	60
3.17 The TEC values of $\text{La}_{1-x}\text{Sr}_x\text{FeO}_3$ ( $x= 0.2, 0.3$ and $0.4$ ).....	62

<b>Table</b>	<b>Page</b>
<b>3.18</b> The TEC values of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Cu}_x\text{O}_3$ ( $x=0, 0.1$ and $0.2$ ).....	63
<b>3.19</b> The TEC values of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{1-x}\text{Ni}_x\text{O}_3$ ( $x=0, 0.1, 0.2$ and $0.3$ ).....	64

## LIST OF FIGURES

Figure	Page
1.1 Flat plate solid oxide fuel cell.....	4
1.2 Operation of a SOFC.....	7
1.3 ABO <sub>3</sub> ideal perovskite structure showing oxygen octahedron containing the B ion linked through corners to form a three-dimensional cubic lattice.....	8
1.4 Mechanism of sintering.....	18
2.1 The calcination condition of perovskite powder.....	25
2.2 The sintering conditions of perovskite.....	26
2.3 DC four-probe methods.....	29
3.1 XRD pattern of La <sub>0.7</sub> Sr <sub>0.3</sub> FeO <sub>3</sub> powder after calcined at 1000°C for 6 hrs.....	32
3.2 XRD patterns of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Cu <sub>x</sub> O <sub>3</sub> (x = 0, 0.1 and 0.2) powders after calcined at 900-1000°C for 6 hrs.....	33
3.3 XRD pattern of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Ni <sub>x</sub> O <sub>3</sub> (x= 0, 0.1, 0.2 and 0.3) powders after calcined at 1000°C for 6 hrs.....	34
3.4 XRD pattern of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Al <sub>x</sub> O <sub>3</sub> (x=0, 0.1, 0.2, 0.3 and 0.4) powders after calcined at 1000°C for 6 hrs.....	36
3.5 XRD pattern of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Mn <sub>x</sub> O <sub>3</sub> (x = 0, 0.1 and 0.2) powders after calcined at 1000°C for 6 hrs.....	37
3.6 Surface morphology of La <sub>0.7</sub> Sr <sub>0.3</sub> FeO <sub>3</sub> disc.....	39
3.7 Surface morphology of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Cu <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2) disc.....	40
3.8 Surface morphology of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Ni <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2 and 0.3) disc.....	41
3.9 Surface morphology of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Al <sub>x</sub> O <sub>3</sub> (x = 0.1, 0.2, 0.3 and 0.4) disc.....	42
3.10 Surface morphology of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Mn <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2) disc.....	43
3.11 H <sub>2</sub> -TPR profiles of La <sub>0.8</sub> Sr <sub>0.2</sub> FeO <sub>3</sub> compound.....	44
3.12 H <sub>2</sub> -TPR profiles of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Cu <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	45
3.13 H <sub>2</sub> -TPR profiles of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Ni <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2 and 0.3).....	46
3.14 H <sub>2</sub> -TPR profiles of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Al <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2, 0.3 and 0.4).....	47

<b>Figure</b>	<b>Page</b>
3.15 H <sub>2</sub> -TPR profiles of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Mn <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	48
3.16 (a) Temperature dependence of the electrical conductivity ( $\sigma$ ) for La <sub>0.7</sub> Sr <sub>0.3</sub> FeO <sub>3</sub> (b) Arrhenius plot of the electrical conductivity of La <sub>0.7</sub> Sr <sub>0.3</sub> FeO <sub>3</sub> .....	50
3.17 Temperature dependence of the electrical conductivity ( $\sigma$ ) for La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Cu <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	51
3.18 Arrhenius plot of the electrical conductivity of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Cu <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	52
3.19 Temperature dependence of the electrical conductivity ( $\sigma$ ) for La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Ni <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2 and 0.3).....	53
3.20 Arrhenius plot of the electrical conductivity of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Ni <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2 and 0.3).....	55
3.21 Temperature dependence of the electrical conductivity ( $\sigma$ ) for La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Al <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2, 0.3 and 0.4).....	56
3.22 Arrhenius plot of the electrical conductivity of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Al <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2, 0.3 and 0.4).....	57
3.23 Temperature dependence of the electrical conductivity ( $\sigma$ ) for La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Mn <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	58
3.24 Arrhenius plot of the electrical conductivity of La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Mn <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	60
3.25 The thermal expansion curves for La <sub>0.7</sub> Sr <sub>0.3</sub> FeO <sub>3</sub> .....	61
3.26 The thermal expansion curves for La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Cu <sub>x</sub> O <sub>3</sub> (x=0.1 and 0.2).....	63
3.27 The thermal expansion curves for La <sub>0.7</sub> Sr <sub>0.3</sub> Fe <sub>1-x</sub> Ni <sub>x</sub> O <sub>3</sub> (x=0.1, 0.2 and 0.3).....	64

## LIST OF ABBREVIATIONS

LSF	$\text{La}_{0.7}\text{Sr}_{0.3}\text{FeO}_3$
LSFCu 0.1	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.9}\text{Cu}_{0.1}\text{O}_3$
LSFCu 0.2	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.8}\text{Cu}_{0.2}\text{O}_3$
LSFNi 0.1	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.9}\text{Ni}_{0.1}\text{O}_3$
LSFNi 0.2	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.8}\text{Ni}_{0.2}\text{O}_3$
LSFNi 0.3	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.7}\text{Ni}_{0.3}\text{O}_3$
LSFAI 0.1	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.9}\text{Al}_{0.1}\text{O}_3$
LSFAI 0.2	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.8}\text{Al}_{0.2}\text{O}_3$
LSFAI 0.3	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.7}\text{Al}_{0.3}\text{O}_3$
LSFAI 0.4	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.6}\text{Al}_{0.4}\text{O}_3$
LSFMn 0.1	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.9}\text{Mn}_{0.1}\text{O}_3$
LSFMn 0.2	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Fe}_{0.8}\text{Mn}_{0.2}\text{O}_3$
SOFC	Solid Oxide Fuel Cell
XRD	X-ray diffractometry
SEM	Scanning Electron Microscopy
TPR	Temperature-programmed reduction
TEC	Thermal Expansion Coefficients
TCD	Thermal conductivity detector
T	temperature
°C	degree Celsius
K	absolute temperature
a,b,c	unit lattice parameter
ml	milliliter (s)
g	gram (s)
kJ	kilo Jule
hrs	hour (s)
mg	milligram (s)
μm	micrometer (s)
Nm	nanometer (s)

min	minute (s)
Å	Angstrom
%	percent
r	Ionic radius
$\sigma$	Specific conductivity