

ปกปก

ผลของวิธีสังเคราะห์ต่อสมบัติของเพอรอฟสไกต์แบบ ABO_3 และ A_2BO_4

นางสาวรัชนิศ หิริโด้ปปะ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

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EFFECTS OF SYNTHESIS METHODS ON PROPERTIES OF ABO_3 AND A_2BO_4
PEROVSKITES

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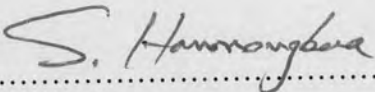
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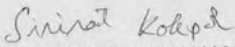
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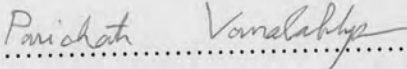
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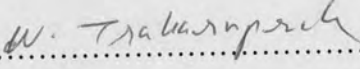

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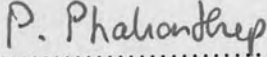
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รชนิศ หิริโอดีปะ : ผลของวิธีสังเคราะห์ต่อสมบัติของเพอโรฟสไกต์แบบ ABO_3 และ A_2BO_4 (EFFECTS OF SYNTHESIS METHODS ON PROPERTIES OF ABO_3 AND A_2BO_4 PEROVSKITES) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ.ดร. อรรวรรณ สงวนเรือง, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: อ.ดร. ปาริฉัตร วนลากพัฒนา 118 หน้า

ศึกษาผลของการลดขนาดอนุภาคของ $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (BSCF), $La_{0.7}Sr_{0.3}Ga_{0.7}Fe_{0.2}Mg_{0.1}O_{3-\delta}$ (LSGFM), $La_{0.8}Sr_{0.2}Ga_{0.8}Mg_{0.15}Co_{0.05}O_{3-\delta}$ (LSGCM), $PrSrCoO_4$ (PSC) และ $PrSrNiO_4$ (PSN) เพื่อปรับปรุงค่าการนำไฟฟ้าและค่าการขยายตัวทางความร้อน สำหรับใช้ออกไอซ์เหล่านี้เป็นวัสดุตัวนำอิเล็กทรอนิกส์และไอออนชนิดใหม่ในเซลล์เชื้อเพลิงของแข็ง ทำการสังเคราะห์สารด้วยวิธีโซลเจลและวิธีไฮโดรเทอร์มอลโดยใช้สารเคมีต่างๆ จากการตรวจสอบเอกลักษณ์ด้วยเทคนิค XRD และ SEM พบว่า BSCF, LSGFM และ LSGCM แสดงเฟสเดียวที่มีโครงสร้างเพอโรฟสไกต์ ABO_3 แบบคิวบิก ในขณะที่ PSC และ PSN แสดงโครงสร้าง K_2NiF_4 แบบเตตระโกนอล นอกจากนี้ขนาดของผลึกและอนุภาคที่เตรียมโดยวิธีไฮโดรเทอร์มอลจะเล็กกว่าและมีความเป็นเนื้อเดียวกันมากกว่าสารที่เตรียมจากวิธีโซลเจล จาก BSCF ทั้งหมดที่เตรียมโดยวิธีโซลเจลโดยมีทั้งเอทิลีนไกลคอลและกรดซิตริกเป็นสารเคมีให้ค่าการนำไฟฟ้าสูงสุด (61.2 ซีเมนต์ต่อเซนติเมตร) ที่ 550 องศาเซลเซียส ส่วน PSC และ PSN ให้ค่าการนำไฟฟ้าสูงสุดเป็น 202.6 ซีเมนต์ต่อเซนติเมตร ที่ 800 องศาเซลเซียส และ 854.5 ซีเมนต์ต่อเซนติเมตร ที่ 27 องศาเซลเซียส ตามลำดับ ในกรณีของ LSGFM และ LSGCM มีค่าการนำไฟฟ้าเป็น 0.32 และ 0.0246 ซีเมนต์ต่อเซนติเมตร ที่ 800 องศาเซลเซียส จากผลของค่าการขยายตัวทางความร้อนพบว่า ค่าสัมประสิทธิ์การขยายตัวทางความร้อนของ BSCF ที่ต่ำที่สุดอยู่ในช่วง $15.6436-24.4395 \times 10^{-6}$ ต่อองศาเซลเซียส สำหรับ PSC และ PSN นั้น ค่าสัมประสิทธิ์การขยายตัวทางความร้อนเป็น 19.7471×10^{-6} และ $11.8786-13.8377 \times 10^{-6}$ ต่อองศาเซลเซียส ส่วน LSGFM และ LSGCM มีค่าสัมประสิทธิ์การขยายตัวทางความร้อนอยู่ในช่วง $14.1057-16.6132 \times 10^{-6}$ และ $5.4556-14.0485 \times 10^{-6}$ ต่อองศาเซลเซียส ตามลำดับ

สาขาวิชา ปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์ ลายมือชื่อนิสิต รหัส

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RATCHANIT HIRI-O-TUPPA: EFFECTS OF SYNTHESIS METHODS
 ON PROPERTIES OF ABO_3 AND A_2BO_4 PEROVSKITES THESIS
 ADVISOR: ASST. PROF. ORAVAN SANGUANRUANG, Ph.D., THESIS
 CO-ADVISOR: PARICHATR VANALABHPATANA, Ph.D., 118 pp.

$Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (BSCF), $La_{0.7}Sr_{0.3}Ga_{0.7}Fe_{0.2}Mg_{0.1}O_{3-\delta}$ (LSGFM),
 $La_{0.8}Sr_{0.2}Ga_{0.8}Mg_{0.15}Co_{0.05}O_{3-\delta}$ (LSGCM), $PrSrCoO_4$ (PSC), $PrSrNiO_4$ (PSN) were
 investigated in the scope of reducing their particle sizes to improve the electrical
 conductivity and thermal expansion coefficient (TEC) for using as a new mixed
 electronic-ionic conducting materials in solid oxide fuel cells (SOFCs). The
 compounds were synthesized by sol gel and hydrothermal methods using various
 chelating agents. Characterized by XRD and SEM, BSCF, LSGFM and LSGCM
 perovskites showed single phase with cubic ABO_3 structure whereas PSC and PSN
 displayed the tetragonal K_2NiF_4 -type structure. Moreover, the crystallite and particle
 sizes of the perovskites synthesized by the hydrothermal method were smaller and more
 homogeneous than those of the sol gel method. Among all of the BSCFs, the BSCF
 synthesized by the sol gel method using ethylene glycol combined with citric acid as
 chelating agents showed highest conductivity (61.2 S/cm) at 550°C. For PSC and PSN
 the maximum conductivity was 202.6 S/cm at 800°C and 854.5 S/cm at 27°C
 respectively. In case of LSGFM and LSGCM, the values were 0.32 S/cm and 0.0246
 S/cm at 800°C. Thermal expansion results, the smallest TEC value of BSCF was in the
 range of $15.6436-24.4395 \times 10^{-6} (\text{°C})^{-1}$. TEC of PSC was $19.7471 \times 10^{-6} (\text{°C})^{-1}$ whereas
 that of PSN was in the range of $11.8786-13.8377 \times 10^{-6} (\text{°C})^{-1}$. TEC values of LSGFM
 and LSGCM were in the ranges of $14.1057-16.6132 \times 10^{-6} (\text{°C})^{-1}$ and $5.4556-14.0485$
 $\times 10^{-6} (\text{°C})^{-1}$ respectively.

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CONTENTS

	Page
ABSTRACT IN THAI	iv
ABSTRACT IN ENGLISH	v
ACKNOWLEDGEMENTS	vi
CONTENTS	vii
LIST OF TABLES	xii
LIST OF FIGURES	xv
LIST OF SCHEMES	xix
LIST OF ABBREVIATIONS	xx
CHAPTER I INTRODUCTION	1
1.1 Fuel cells	1
1.2 Solid oxide fuel cells	3
1.2.1 Cathode	4
1.2.2 Electrolyte	5
1.2.3 Anode	5
1.2.4 Interconnection	6
1.3 Perovskite	6
1.3.1 Structure of perovskite oxide	7
1.3.1.1 ABO_3 - type	7
1.3.1.2 A_2BO_4 - type	9
1.3.2 Physical properties of perovskite	10
1.3.2.1 Dielectric and ferroelectric perovskites	10
1.3.2.2 Magnetism and electronic correlations	11
1.3.2.3 Mixed ionic-electronic conductors	12
1.3.3 Oxygen adsorption property	13
1.3.4 Nanotechnology	13
1.3.4.1 Nanomaterials	14
1.3.4.2 Nanoparticles	15

	Page
1.3.5 Perovskite synthesis.....	16
1.3.5.1 Solid-state reaction.....	16
1.3.5.2 Sol-gel Process.....	16
1.3.5.3 Hydrothermal synthesis.....	19
1.3.6 Powder sizing.....	19
1.3.7 Powder compacting by uniaxial pressing.....	20
1.3.8 Sintering.....	20
1.4 Electrical measurement.....	22
1.4.1 Two-Point Measurements.....	22
1.4.2 Four-Point Measurements.....	23
1.5 Literature reviews.....	24
1.6 The objectives of the thesis.....	28
CHAPTER II EXPERIMENTAL.....	29
2.1 Chemicals.....	29
2.2 Synthesis of perovskite powder by sol gel method.....	31
2.3 Synthesis of perovskite powder by hydrothermal method.....	36
2.4 Perovskite disc preparation.....	40
2.5 The Sintering of the Perovskite Oxides.....	41
2.6 Characterization of the perovskite oxides.....	42
2.6.1 X-ray diffractometry (XRD).....	42
2.6.2 Scanning electron microscopy (SEM).....	42
2.6.3 Electrical conductivity Measurement.....	42
2.6.4 Dilatometer.....	43
CHAPTER III RESULTS AND DISSCUSSIONS.....	44
3.1 Synthesis of perovskite oxide.....	44
3.1.1 Sol gel method.....	44
3.1.2 Hydrothermal method.....	45
3.2 Characterization of the perovskite compounds.....	46
3.2.1 X-ray diffraction (XRD).....	46
3.2.1.1 Phase formation of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (synthesized by sol gel method).....	47

3.2.1.2 Phase formation of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ (synthesized by hydrothermal method).....	48
3.2.1.3 Phase formation of PrSrCoO_4 (synthesized by sol gel method).....	50
3.2.1.4 Phase formation of PrSrCoO_4 (synthesized by hydrothermal method).....	51
3.2.1.5 Phase formation of PrSrNiO_4 (synthesized by sol gel method).....	52
3.2.1.6 Phase formation of PrSrNiO_4 (synthesized by hydrothermal method).....	53
3.2.1.7 Phase formation of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_3$ (synthesized by hydrothermal method).....	54
3.2.1.8 Phase formation of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ (synthesized by hydrothermal method).....	55
3.2.2 Scanning electron microscope (SEM) and density.....	57
3.2.2.1 The morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ particles (synthesized by sol gel method).....	58
3.2.2.2 The morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ particles (synthesized by hydrothermal method).....	60
3.2.2.3 The morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ sintered disc (synthesized by sol gel method).....	62
3.2.2.4 The morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ sintered disc (synthesized by hydrothermal method).....	63
3.2.2.5 The morphology of PrSrCoO_4 particles (synthesized by sol gel method).....	65
3.2.2.6 The morphology of PrSrCoO_4 particles (synthesized by hydrothermal method).....	67
3.2.2.7 The morphology of PrSrCoO_4 sintered disc (synthesized by hydrothermal method).....	68
3.2.2.8 The morphology of PrSrNiO_4 particles (synthesized by sol gel method).....	70

3.2.2.9 The morphology of PrSrNiO ₄ particles (synthesized by hydrothermal method).....	72
3.2.2.10 The morphology of PrSrNiO ₄ sintered disc (synthesized by hydrothermal method).....	74
3.2.2.11 The morphology of La _{0.7} Sr _{0.3} Ga _{0.7} Fe _{0.2} Mg _{0.1} O ₃ sintered disc (synthesized by hydrothermal method).....	76
3.2.2.12 The morphology of La _{0.8} Sr _{0.2} Ga _{0.8} Mg _{0.15} Co _{0.05} O _{3-δ} sintered disc (synthesized by hydrothermal method).....	77
3.2.3 Electrical conductivity.....	78
3.2.3.1 Effect of chelating agents on the electrical conductivity of Ba _{0.5} Sr _{0.5} Co _{0.8} Fe _{0.2} O _{3-δ} synthesized by sol gel method.....	78
3.2.3.2 Effect of chelating agents on the electrical conductivity of Ba _{0.5} Sr _{0.5} Co _{0.8} Fe _{0.2} O _{3-δ} synthesized by hydrothermal method.....	81
3.2.3.3 Effect of chelating agents on the electrical conductivity of PrSrCoO ₄ synthesized by hydrothermal method.....	83
3.2.3.4 Effect of chelating agents on the electrical conductivity of PrSrNiO ₄ synthesized by hydrothermal method.....	85
3.2.3.5 Effect of chelating agents on the electrical conductivity of La _{0.7} Sr _{0.3} Ga _{0.7} Fe _{0.2} Mg _{0.1} O ₃ synthesized by hydrothermal method.....	87
3.2.3.6 Effect of chelating agents on the electrical conductivity of La _{0.8} Sr _{0.2} Ga _{0.8} Mg _{0.15} Co _{0.05} O _{3-δ} synthesized by hydrothermal method.....	89
3.2.4 Thermal expansion coefficients.....	91
3.2.4.1 Effect of chelating agents on thermal expansion of Ba _{0.5} Sr _{0.5} Co _{0.8} Fe _{0.2} O _{3-δ}	91
3.2.4.2 Effect of chelating agents on thermal expansion of PrSrCoO ₄	93

	Page
3.2.4.3 Effect of chelating agents on thermal expansion of PrSrNiO_4	94
3.2.4.4 Effect of chelating agents on thermal expansion of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$	95
3.2.4.5 Effect of chelating agents on thermal expansion of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$	96
CHAPTER IV CONCLUSIONS	97
REFERENCES	99
APPENDICES	104
VITAE	119

LIST OF TABLES

Table	Page
1.1 Types of fuel cells	2
2.1 Reagents for synthesis of perovskite	29
2.2 The components of all samples	30
2.3 Chelating agents for synthesis of perovskites	30
2.4 Abbreviation of perovskites were synthesized by sol gel method	31
2.5 List of the features of the perovskite compounds during preparation by sol gel method	33
2.6 Abbreviation of perovskites were synthesized by hydrothermal method	35
2.7 List of the features of the perovskite compounds during preparation by hydrothermal method	37
3.1 Chelating agent structure	45
3.2 Crystallite sizes of synthesized BSCF powders by sol gel method using different chelating agents	48
3.3 Crystallite sizes of synthesized BSCF powders by hydrothermal method using different chelating agents	49
3.4 Crystallite sizes of synthesized PSC powders by sol gel method using different chelating agents	50
3.5 Crystallite sizes of synthesized PSC powders by hydrothermal method different chelating agents	51
3.6 Crystallite sizes of synthesized PSN powders by sol gel method using different chelating agents	52
3.7 Crystallite sizes of synthesized PSN powders by hydrothermal method using different chelating agents	53
3.8 Particle sizes of synthesized $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ powders by sol gel method using different chelating agents	60
3.9 Particle sizes of synthesized $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ powders by sol gel and hydrothermal method using different chelating agents	61

3.10 Density of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ discs synthesized by sol gel method using different chelating agents.....	63
3.11 Density of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ discs synthesized by hydrothermal method using different chelating agents.....	65
3.12 Particle sizes of synthesized PrSrCoO_4 powders by sol gel method using different chelating agents.....	66
3.13 Particle sizes of synthesized PrSrCoO_4 powders by sol gel and hydrothermal method using different chelating agents.....	68
3.14 Density of PrSrCoO_4 disc synthesized by hydrothermal method using different chelating agents.....	70
3.15 Particle sizes of synthesized PrSrNiO_4 powders by sol gel method using different chelating agents.....	71
3.16 Particle sizes of synthesized PrSrNiO_4 powders by sol gel method compared with hydrothermal method.....	74
3.17 Density of PrSrNiO_4 disc synthesized by hydrothermal method using different chelating agents.....	76
3.18 Density of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ discs synthesized by hydrothermal method with using different chelating agents.....	77
3.19 Density of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ discs synthesized by hydrothermal method with using different chelating agents.....	77
3.20 Activation energy of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ synthesized by sol gel method using various chelating agents.....	81
3.21 Activation energy of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ synthesized by hydrothermal method using various chelating agents.....	82
3.22 Activation energy of PrSrCoO_4 synthesized by hydrothermal method using various chelating agents.....	84
3.23 Activation energy of PrSrNiO_4 synthesized by hydrothermal method using various chelating agents.....	86
3.24 Activation energy of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ synthesized by hydrothermal method using various chelating agents.....	88

3.25 Activation energy of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ synthesized by hydrothermal method using citric acid as a chelating agent	90
3.26 The TEC values of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$	92
3.27 The TEC values of PrSrCoO_4	93
3.28 The TEC values of PrSrNiO_4	94
3.29 The TEC values of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$	96
3.30 The TEC values of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$	97

LIST OF FIGURES

Figure	Page
1.1 Solid Oxide Fuel Cell Designs at the Cathode.....	3
1.2 Solid Oxide Fuel Cell Operating Principle.....	4
1.3 ABO_3 ideal perovskite structure.....	7
1.4 The relationship of ionic radii in perovskite structure.....	8
1.5 Crystal structure of A_2BO_4 -type oxide.....	9
1.6 Mechanism of sintering; X is the internal radius of the neck; r is the particle radius.....	22
1.7 4-DC probe measurements.....	23
2.1 KBr die.....	40
3.1 The XRD patterns of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ powders synthesized by sol gel method using various chelating agents.....	47
3.2 The XRD patterns of $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ powders synthesized by hydrothermal method using various chelating agents.....	48
3.3 The XRD patterns of $PrSrCoO_4$ powders synthesized by sol gel method using various chelating.....	50
3.4 The XRD patterns of $PrSrCoO_4$ powders synthesized by hydrothermal method using various chelating agents.....	51
3.5 The XRD patterns of $PrSrNiO_4$ powders synthesized by sol gel method using various chelating agents.....	52
3.6 The XRD patterns of $PrSrNiO_4$ powders synthesized by hydrothermal method using various chelating.....	53
3.7 The XRD patterns of single phase $La_{0.7}Sr_{0.3}Ga_{0.7}Fe_{0.2}Mg_{0.1}O_{3-\delta}$ sintered disc synthesized by hydrothermal method using various chelating agents after sintered at 1450°C for 10 hours.....	54
3.8 The XRD patterns of $La_{0.7}Sr_{0.3}Ga_{0.7}Fe_{0.2}Mg_{0.1}O_{3-\delta}$ sintered disc synthesized by hydrothermal method with using various chelating agents after sintered at 1450°C for 10 hours.....	55

3.9 The XRD patterns of single phase $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ sintered disc synthesized by hydrothermal method using various chelating agents after sintered at 1450°C for 10 hours.....	56
3.10 The XRD patterns of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ sintered disc synthesized by hydrothermal method using various chelating agents after sintered at 1450°C for 10 hours.....	57
3.11 Surface morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ particles synthesized by sol gel method using various chelating agents after calcined at 900°C for 6 hours.....	59
3.12 Surface morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ particles synthesized by hydrothermal method using various chelating agents after calcined at 900°C for 6 hours.....	61
3.13 Surface morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ sintered disc synthesized by sol gel method using various chelating agents after sintered at 1100°C for 10 hours.....	62
3.14 Surface morphology of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ sintered disc synthesized by hydrothermal method using various chelating agents after sintered at 1100°C for 10 hours.....	64
3.15 Surface morphology of PrSrCoO_4 particles synthesized by sol gel method using various chelating agents after calcined at 900°C for 6 hours.....	66
3.16 Surface morphology of PrSrCoO_4 particles synthesized by hydrothermal method using various chelating agents after calcined at 900°C for 6 hours.....	67
3.17 Surface morphology of PrSrCoO_4 sintered disc synthesized by hydrothermal method using various chelating agents after sintered at 1200°C for 10 hours.....	69
3.18 Surface morphology of PrSrNiO_4 particles synthesized by sol gel method using various chelating agents after calcined at 900°C for 6 hours.....	71
3.19 Surface morphology of PrSrNiO_4 particles synthesized by hydrothermal method using various chelating agents after calcined at 900°C for 6 hours.....	73
3.20 Surface morphology of PrSrNiO_4 sintered disc synthesized by hydrothermal method using various chelating agents after sintered at 1200°C for 10 hours.....	75

3.21 Surface morphology of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ sintered disc synthesized by hydrothermal method using citric acid and glycine-citrate as chelating agents after sintered at 1450°C for 10 hours	76
3.22 Surface morphology of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ sintered disc synthesized by hydrothermal method using citric acid as chelating agents after sintered at 1450°C for 10 hours	77
3.23 Variations of the electrical conductivity measured in air of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ by sol gel method using various chelating agents with temperature	78
3.24 Arrhenius plot of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ synthesized by sol gel method using various chelating agents	80
3.25 Variations of the electrical conductivity measured in air of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ by hydrothermal method using various chelating agents with temperature	81
3.26 Arrhenius plot of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ synthesized by hydrothermal method using various chelating agents	82
3.27 Variations of the electrical conductivity measured in air of PrSrCoO_4 by sol gel method using various chelating agents with temperature	83
3.28 Arrhenius plot of PrSrCoO_4 synthesized by hydrothermal method using various chelating agents	84
3.29 Variations of the electrical conductivity measured in air of PrSrNiO_4 by hydrothermal method using various chelating agents with temperature	85
3.30 Arrhenius plot of PrSrNiO_4 synthesized by hydrothermal method using various chelating agents	86
3.31 Variations of the electrical conductivity measured in air of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ by hydrothermal method using various chelating agents with temperature	87
3.32 Arrhenius plot of $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ synthesized by hydrothermal method using various chelating agents	88
3.33 Variations of the electrical conductivity measured in air $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ by hydrothermal method using various chelating agents with temperature	89

3.34 Arrhenius plot of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ synthesized by hydrothermal method using citric acid as chelating agents.....	90
3.35 The thermal expansion curves for $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$	91
3.36 The thermal expansion curves for PrSrCoO_4	93
3.37 The thermal expansion curves for PrSrNiO_4	94
3.38 The thermal expansion curves for $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$	95
3.39 The thermal expansion curves for $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$	96

LIST OF SCHEMES

Scheme	Page
2.1 The condition of calcination for $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$, PrSrCoO_4 and PrSrNiO_4 (a), $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ and $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ (b).....	32
2.2 The condition of sintering process of $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$ (a), $\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_{3-\delta}$ and $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$ (b), PrSrCoO_4 and PrSrNiO_4 (c).....	41

LIST OF ABBREVIATIONS

BSCF	$\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$
PSC	PrSrCoO_4
PSN	PrSrNiO_4
LSGFM	$\text{La}_{0.7}\text{Sr}_{0.3}\text{Ga}_{0.7}\text{Fe}_{0.2}\text{Mg}_{0.1}\text{O}_3$
LSGMC	$\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_{3-\delta}$
S	Sol gel method
H	Hydrothermal method
MC	Citric Acid
G	Glycine
H_5DTPA , H_5	Diethylenetriaminepentaacetic Acid
GC	Citric Acid + Glycine
EC	Ethylene glycol + Citric Acid
SOFC	Solid Oxide Fuel Cell
MIEC	Mixed Ionic Electronic Conductor
EDTA	Ethylene Diamine Tetraacetic Acid
XRD	X-ray diffractometer
SEM	Scanning electron microscopy
TEC	Thermal expansion coefficient
STP	Standard temperature and pressure
R	Electrical resistance
V	Voltage
g	gram (s)
h	hour (s)
%	percent
$^{\circ}\text{C}$	Degree celsius
a	Cubic unit lattice parameter
r	Ionic radius
t	Tolerance factor
σ	specific conductivity
μm	Micrometer
k	Temperature constant

n, m	Mechanism growth constant
X	Internal radius of the neck
Å	Angstrom
δ	Oxygen non-stoichiometry
D_v, k_r, k_f	Functions of temperature
ml	Milliliter
ρ	Specific resistance
A	Area
l	Length
I	Electrical current