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FACTORS AFFECTING THE SYNTHESIS OF COBALT-TITANIUM SILICALITE-1
CATALYST

Miss Nattaporn Jiravasavanich

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Chemical Engineering

Department of Chemical Engineering

Faculty of Engineering

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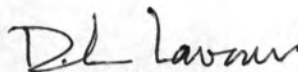
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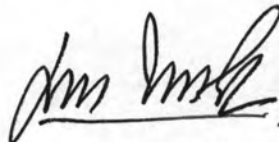
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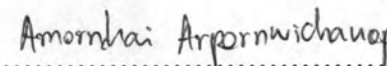
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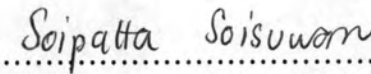

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ณัฐพร จีระสรวาณิชย์: ปัจจัยที่มีผลต่อการสังเคราะห์ตัวเร่งปฏิกิริยาโคบอลต์-ไทเทเนียมซิลิกาไลต์-1 (FACTORS AFFECTING THE SYNTHESIS OF COBALT-TITANIUM SILICALITE-1 CATALYST.) อ. ที่ปรึกษา : รศ.ดร.ชราธร มงคลศรี, 146 หน้า.

งานวิจัยนี้ได้ทำการศึกษาปัจจัยที่ส่งผลต่อการเตรียมตัวเร่งปฏิกิริยา Co-TS-1 โดยตัวเร่งปฏิกิริยาดังกล่าวถูกสังเคราะห์ด้วยวิธีไฮโดรเทอร์มอล โดยมีอัตราส่วนอะตอมของซิลิกอนต่อไทเทเนียม และซิลิกอนต่อโคบอลต์ถูกกำหนดเป็น 50 และ 150 ตามลำดับ โดยมีการใช้ชนิดของเกลือโคบอลต์ที่ต่างกัน (โคบอลต์ไนเตรทเฮกซะไฮเดรต โคบอลต์คลอไรด์เฮกซะไฮเดรต และโคบอลต์อะซิเตรทเตตระไฮเดรต) และมีการใส่โลหะโคบอลต์ลงในสารละลายที่ต่างกัน (สารละลาย A1 A2 C1 และ A1A2) เข้าไปในระหว่างการสังเคราะห์ผลึก TS-1 ตัวเร่งปฏิกิริยาที่สังเคราะห์ได้ (Co-TS-1) ถูกวิเคราะห์ด้วยเทคนิค XRF, SEM, XRD, BET, FT-IR และ NH₃-TPD จากนั้นจึงทำการทดสอบความสามารถในการทำปฏิกิริยาที่เปลี่ยนไปโดยใช้ปฏิกิริยาการออกซิไดส์ 2-โพรพานอลด้วยออกซิเจนในวัฏภาคแก๊สในช่วงอุณหภูมิ 100-500°C ที่มีความเข้มข้น 2-โพรพานอลร้อยละ 5 โดยปริมาตร และออกซิเจนร้อยละ 8 โดยปริมาตร จากการศึกษาพบว่า การเปลี่ยนชนิดของสารประกอบโคบอลต์ และการเปลี่ยนกลุ่มการใส่ของโลหะโคบอลต์มีผลต่อปริมาณการเข้าไปในโครงสร้างของโลหะโคบอลต์ และไทเทเนียม ทั้งนี้เป็นเพราะค่า pH ของเกลือแต่ละชนิดมีค่าไม่เท่ากัน และค่า pH ของเกลือโคบอลต์ในช่วงเบสเป็นค่าที่เหมาะสมสำหรับการใส่โคบอลต์เข้าไปในโครงสร้าง แต่อย่างไรก็ตามลักษณะโครงสร้างของตัวเร่งปฏิกิริยาที่สังเคราะห์ได้ทั้งหมดยังคงมีโครงสร้างแบบ MFI และมีรูปร่างแบบ orthorhombic โดยการเข้าไปของโลหะโคบอลต์ในโครงสร้าง TS-1 มาจากกลุ่มสารละลายที่เป็นเจลเท่านั้น เทคนิคการดูดซับแอมโมเนียพบว่าการมีโคบอลต์ในโครงสร้างทำให้เพิ่มสัดส่วนตำแหน่งที่เป็นกรดแก่มากกว่าตัวเร่งปฏิกิริยาที่ไม่มีโลหะโคบอลต์ แต่ปริมาณโคบอลต์ที่มากขึ้นจะเพิ่มตำแหน่งที่เป็นกรดอ่อนมากกว่า ดังนั้นปริมาณโคบอลต์ในโครงสร้างที่มากขึ้น ทำให้ปริมาณสัดส่วนความเป็นกรดรวมบนผิวตัวเร่งปฏิกิริยาเพิ่มขึ้นอย่างเห็นได้ชัด จากคุณสมบัติดังกล่าว เมื่อตัวเร่งปฏิกิริยาที่มีปริมาณโลหะโคบอลต์แตกต่างกันมาทดสอบกับปฏิกิริยาการออกซิไดส์ของ 2-โพรพานอล พบว่าตัวเร่งปฏิกิริยาที่มีปริมาณโคบอลต์ที่มากขึ้นมีแนวโน้มการเลือกเกิดปฏิกิริยาดีไฮเดรชันสูงขึ้น

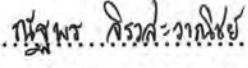

ภาควิชา.....วิศวกรรมเคมี..... ลายมือชื่อนิสิต.....ณัฐพร.....จิระสรวาณิชย์.....
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##4870286521 MAJOR CHEMICAL ENGINEERING

KEY WORD: COBALT-TITANIUM SILICALITE 1

NATTAPORN JIRAVASAVANICH: FACTORS AFFECTING THE SYNTHESIS OF COBALT-TITANIUM SILICALITE-1 CATALYST. THESIS ADVISOR: ASSOC. PROF. THARATHON MONGKHONSI, Ph.D. 146 pp.

This research has studied factors affecting the preparation of Co-TS-1 catalysts which were synthesized by the hydrothermal method. The atomic ratios of Si/Ti and Si/Co were set as 50 and 150, respectively. The synthesized TS-1 that incorporated with various types of cobalt salt ($(\text{Co}(\text{NO}_3)_2) \cdot 6\text{H}_2\text{O}$, $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$) and different loading solutions (A1, A2, C1 and A1A2 solutions). The Co-TS-1 catalysts were characterized by various techniques XRF, SEM, XRD, BET, FT-IR and NH_3 -TPD. The catalytic activity of Co-TS-1 were investigated by using the gas phase oxidation reaction of 2-propanol as the test reaction. The gas mixtures for oxidation reaction were 5 vol% 2-propanol and 8 vol% oxygen at temperature between 100-500°C. The study reveals that the various types of cobalt salt and different loading solution of incorporated cobalt have effect to the amount of cobalt and titanium that can incorporate into framework. Because of the different pH value of each salt, the high pH value of cobalt salt as a base is suitable for cobalt loading. However, the formed catalysts can still maintain MFI structure and orthorhombic crystal shape. The majority of cobalt metal only offered to the gel solution can incorporate into TS-1 framework. The NH_3 -TPD shows that the existence of cobalt in framework increases the amount of stronger acid sites ratio rather than the non-existence cobalt catalyst. Moreover, the higher amount of cobalt that incorporated into TS-1 framework will increase the weaker acid sites ratio. Therefore, the increasing of cobalt metal also results in the increasing of total acid sites. Because of those properties, when the catalyst sample with higher amount of loaded cobalt is tested by 2-propanol oxidation, the higher catalytic activity for the dehydration reaction toward propylene is increased.

Department.....Chemical Engineering... Student's signature... .....
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CONTENTS

	PAGE
ABSTRACT (IN THAI).....	iv
ABSTRACT (IN ENGLISH).....	v
ACKNOWLEDGMENTS.....	vi
CONTENTS.....	vii
LIST OF TABLES.....	x
LIST OF FIGURES.....	xi
CHAPTER	
I INTRODUCTION.....	1
1.1 Introduction.....	1
II THEORY.....	8
2.1 General feature of titanium silicalite (TS-1).....	8
2.2 Catalyst properties.....	11
2.2.1 Physical and mechanical properties.....	11
2.2.2 Chemical and mechanical properties.....	11
2.2.3 Dynamic (catalytic) properties.....	11
2.3 Parameters affecting the synthesis of TS-1 catalysts.....	11
2.3.1 Catalyst Synthesis Method.....	13
2.3.2 Effect of templates.....	16
2.3.3 Alkalinity.....	16
2.3.4 Temperature.....	17
2.3.5 Time.....	17
2.3.6 Dilution.....	18
2.3.7 Inorganic cation.....	18
2.3.8 Promoter.....	18
2.4 Catalytic activity.....	19
2.4.1 Shape selectivity.....	19
2.4.2 Catalytic sites in TS-1.....	20
2.5 Reaction of alcohols.....	20
2.5.1 Oxidation.....	21
2.5.2 Dehydration.....	22

	PAGE
2.5.3 Combustion.....	23
III LITERATURE REVIEWS.....	24
3.1 Literature reviews.....	24
3.1.1 Effect of the synthetic method of titanium silicalite-1 (TS-1)	24
3.1.2 Effect of the modified TS-1 for several reactions.....	27
3.1.3 Effect of cobalt on catalyst properties	28
3.2 Comment on previous works	31
IV EXPERIMENTS.....	32
4.1 Catalyst preparation	32
4.1.1 Preparation of Solutions	35
4.1.2 Crystallization.....	38
4.1.3 Calcination.....	38
4.2 Catalyst characterization.....	38
4.2.1 X-ray fluorescence spectroscopy (XRF).....	38
4.2.2 Scanning electron microscopy (SEM).....	39
4.2.3 X-ray diffraction (XRD).....	39
4.2.4 BET surface area and pore volume measurement.....	39
4.2.5 Fourier transform infrared (FT-IR).....	40
4.2.6 Temperature programmed desorption (NH ₃ -TPD).....	40
4.3 The catalytic activity measurements.....	41
4.3.1 Equipment.....	41
4.3.2 Oxidation procedure.....	42
V RESULTS AND DISCUSSION	45
5.1 Catalyst characterization of Co-TS-1 samples	45
5.1.1 Determination of Chemical compositions of the synthesized Co-TS-1 Samples.....	45
5.1.2 Morphology.....	50
5.1.3 Crystalline structure.....	54
5.1.4 BET surface area, pore volume and pore size of the synthesized Co-TS-1 catalyst.....	56
5.1.5 The functional group in the catalysts.....	58
5.1.6 Acid quantities and acid strength.....	60

	PAGE
5.2 Catalytic reaction of 2-propanol oxidation.....	74
5.2.1 Selective oxidation ability.....	83
5.2.2 Dehydration ability.....	84
5.2.3 Combustion ability.....	85
VI CONCLUSIONS AND RECOMMENDATIONS.....	88
6.1 Conclusions.....	88
6.2 Recommendations for future studies.....	89
REFERENCES.....	90
APPENDICES.....	94
APPENDIX A: BASIC INFORMATION OF COBALT.....	95
APPENDIX B: CALCULATION FOR CATALYST PREPARATION.....	101
APPENDIX C: THE DATA OF X-RAY FLUORESCENCE (XRF).....	104
APPENDIX D: DATA AND CALCULATION OF ACID SITE.....	113
APPENDIX E: DATA OF EXPERIMENTS.....	116
APPENDIX F: CALIBRATION CURVES	125
APPENDIX G: MATERIAL SAFETY DATA SHEETS.....	128
VITA.....	146

LIST OF TABLES

Table	page
1.1 Former researches of effect of 2 nd metal loaded into TS-1 catalyst.....	6
2.1 Comparison of crystal growth methods [West,(1984)].....	15
4.1 The chemicals used in the Co-TS-1 catalyst preparation.....	33
4.2 The reagents used for preparing Co-TS-1 (Si/Ti = 50, Si/Co = 150).....	36
4.3 The amount of cobalt salts indicated as 'X' for synthesizing various catalyst samples (Si/Ti = 50, Si/Co = 150).....	37
4.4 Operating conditions for gas chromatograph.....	42
5.1 Chemical composition of the synthesized Co-TS-1 samples.....	46
5.2 BET surface area, pore volume and average pore size of the synthesized Co-TS-1 samples.....	57
5.3 Desorption temperature and acid site quantities of the synthesized Co-TS-1 sample with different cobalt salts.....	63
5.4a-j Data of acid quantities and acid strength.....	64
A1 Physical properties of the cobalt	96
C1 Chemical composition of the synthesized Co-TS-1 samples.....	112
D1 Reported total peak area from Micromeritics Chemisorb 2750.....	113
E1 Data of Figure 5.8a ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A1).....	116
E2 Data of Figure 5.8b ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A2).....	116
E3 Data of Figure 5.8c ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to C1).....	117
E4 Data of Figure 5.8d ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A1 and A2).....	117
E5 Data of Figure 5.8e ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to A1).....	117
E6 Data of Figure 5.8f ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to C1).....	118
E7 Data of Figure 5.8g ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to A1 and A2).....	118
E8 Data of Figure 5.8h ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to A1).....	118
E9 Data of Figure 5.8i ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to C1).....	119
E10 Data of Figure 5.8j ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to A1 and A2).....	119

LIST OF FIGURES

Figure	page
2.1 Structure of MFI a) The MFI framework topology b) 10-ring viewed along [010] (straight channel) and c) 10-ring viewed along [100] sinusoidal channel.....	8
2.2 Framework of TS-1.....	10
2.3 Pore and channel structure of TS-1.....	10
2.4 Parameters affecting the properties of catalyst	12
2.5 Triangle concept for catalyst design. Catalyst design is an optimized combination of interdependent mechanical, chemico-physical and catalytic properties.....	13
2.6 (a) Pressure-temperature relations for water at constant volume. Dashed curves represent pressures developed inside a closed vessel; numbers represent the percentage degree of filling of the vessel by water at ordinary P, T. (After Kennedy, 1950). (b) Schematic hydrothermal bomb used for crystal growth	14
4.1 The preparation procedure of Co-TS-1 by hydrothermal method.....	34
4.2 Flow diagram of the oxidation reaction system.....	44
5.2a SEM photo of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A1).....	50
5.2b SEM photo of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A2).....	50
5.2c SEM photo of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to C1).....	51
5.2d SEM photo of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A1 and A2).....	51
5.2e SEM photo of Co-TS-1 ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to A1).....	51
5.2f SEM photo of Co-TS-1 ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to C1).....	52
5.2g SEM photo of Co-TS-1 ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to A1 and A2).....	52
5.2h SEM photo of Co-TS-1 ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to A1).....	52
5.2i SEM photo of Co-TS-1 ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to C1).....	53
5.2j SEM photo of Co-TS-1 ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to A1 and A2).....	53
5.3a XRD spectra of the Co-TS-1 catalyst which used $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ as cobalt salt.....	55

Figure	Page
5.3b XRD spectra of the Co-TS-1 catalyst which used $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ as cobalt salt.....	55
5.3c XRD spectra of the Co-TS-1 catalyst which used $\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ as cobalt salt.....	56
5.4a IR spectra of the synthesized Co-TS-1 catalyst which used $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ as cobalt salt.....	59
5.4b IR spectra of the synthesized Co-TS-1 catalyst which used $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ as cobalt salt.....	59
5.4c IR spectra of the synthesized Co-TS-1 catalyst which used $\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ as cobalt salt.....	60
5.5a The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A1).....	64
5.5b The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A2).....	65
5.5c The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to C1).....	66
5.5d The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ loading to A1 and A2).....	67
5.5e The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to A1).....	68
5.5f The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to C1).....	69
5.5g The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ loading to A1 and A2).....	70
5.5h The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to A1).....	71
5.5i The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to C1).....	72
5.5j The relation of TCD signal, temperature and time and the data of peak fitting of Co-TS-1 ($\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ loading to A1 and A2).....	73

Figure	page
5.6 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A1).....	74
5.7 Schematic pathway of product formation in 2-propanol oxidation reaction.....	75
5.8a The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A1).....	78
5.8b The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A2).....	78
5.8c The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to C1).....	79
5.8d The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A1 and A2).....	79
5.8e The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (CoCl ₂ ·6H ₂ O loading to A1).....	80
5.8f The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (CoCl ₂ ·6H ₂ O loading to C1).....	80
5.8g The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (CoCl ₂ ·6H ₂ O loading to A1 and A2).....	81
5.8h The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(C ₂ H ₃ O ₂) ₂ ·4H ₂ O loading to A1).....	81
5.8i The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(C ₂ H ₃ O ₂) ₂ ·4H ₂ O loading to A1).....	82
5.8j The conversion (C) and selectivity (S) of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(C ₂ H ₃ O ₂) ₂ ·4H ₂ O loading to A1 and A2).....	82
5.9 TGA analysis the spent Co-TS-1 (CoCl ₂ ·6H ₂ O loading to C1) catalysts.....	86
E1 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A1).....	120
E2 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A2).....	120

Figure	page
E3 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to C1).....	121
E4 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(NO ₃) ₂ ·6H ₂ O loading to A1 and A2).....	121
E5 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (CoCl ₂ ·6H ₂ O loading to A1).....	122
E6 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (CoCl ₂ ·6H ₂ O loading to C1).....	122
E7 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (CoCl ₂ ·6H ₂ O loading to A1 and A2).....	123
E8 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(C ₂ H ₃ O ₂) ₂ ·4H ₂ O loading to A1).....	123
E9 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(C ₂ H ₃ O ₂) ₂ ·4H ₂ O loading to A1).....	124
E10 The amount of product of 2-propanol over Co-TS-1 for 8 Vol% O ₂ system (Co(C ₂ H ₃ O ₂) ₂ ·4H ₂ O loading to A1 and A2).....	124
F1 The calibration curve of 2-propanol.....	125
F2 The calibration curve of propylene.....	126
F3 The calibration curve of acetone	126
F4 The calibration curve of isopropyl ether	127
F5 The calibration curve of carbon dioxide.....	127