

การแตกตัวเชิงแรงปฏิกิริยาของกลีเซอรอลด้วยเอสบีเอ-15 ที่รองรับโลหะ



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CATALYTIC CRACKING OF GLYCEROL USING METAL-SUPPORTED SBA-15

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**A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Petrochemistry and Polymer Science**

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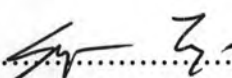
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ชัยยุทธ ทองกุลทัศน์ : การแตกตัวเชิงเร่งปฏิกิริยาของกลีเซอรอลด้วยเอสบีเอ-15 ที่รองรับโลหะ (CATALYTIC CRACKING OF GLYCEROL USING METAL-SUPPORTED SBA-15) อ.ที่ปริกษาวิทยานิพนธ์หลัก: คร. ดวงกมล นันทศรี, 123 หน้า

ได้สังเคราะห์เอสบีเอ-15 เป็นซิลิกาที่มีรูพรุนขนาดกลางด้วยวิธีไฮโดรเทอร์มัล ใช้ไทรบิล็อกโคพอลิเมอร์ชนิด P123 (พอลิเอทิลีนออกไซด์₂₀-พอลิโพรพิลีนออกไซด์₇₀-พอลิเอทิลีนออกไซด์₂₀) เป็นสารชี้นำโครงสร้าง มีองค์ประกอบของเจลเป็น 1.00 TEOS : 1.65×10⁻² P123 : 6.95 HCl : 140 H₂O ที่อุณหภูมิ 100 องศาเซลเซียส เป็นเวลา 48 ชั่วโมง อะลูมิเนียม-เอสบีเอ-15 เตรียมโดยการเติมอะลูมิเนียมไปในโครงสร้างเอสบีเอ-15 นอกจากนี้ได้เตรียมโลหะนิกเกิล แพลทินัม แพลเลเดียมและรูทีเนียม บนตัวรองรับเอสบีเอ-15 โดยวิธีทำให้เปียก จากนั้นตรวจสอบลักษณะเฉพาะของวัสดุที่สังเคราะห์ได้ด้วยเทคนิคการเลี้ยวเบนของรังสีเอกซ์ เทคนิคการดูดซับไนโตรเจน การคายรังสีจากอะตอมโดยใช้พลาสมาเหนี่ยวนำ อะลูมิเนียมนิวเคลียร์แมกเนติกเรโซแนนซ์สำหรับสถานะของแข็ง กล้องจุลทรรศน์อิเล็กตรอนแบบส่องกราด และกล้องจุลทรรศน์อิเล็กตรอนแบบส่องผ่าน จากนั้นนำกลีเซอรอลบริสุทธิ์และของเสียดกลีเซอรอลมาใช้เป็นสารตั้งต้นในการทดสอบความว่องไวของตัวเร่งปฏิกิริยาอะลูมิเนียมเอสบีเอ-15 และตัวเร่งปฏิกิริยาที่มีโลหะบนตัวรองรับเอสบีเอ-15 ตัวแปรที่มีผลต่อปฏิกิริยา ได้แก่ ชนิดของตัวเร่งปฏิกิริยา อุณหภูมิ อัตราส่วนตัวเร่งปฏิกิริยาต่อสารตั้งต้น ขนาดอนุภาคของโลหะ และตำแหน่งของตัวเร่งปฏิกิริยา ภาวะที่เหมาะสมสำหรับการแตกตัวของของเสียดกลีเซอรอลคือที่อุณหภูมิ 650 องศาเซลเซียส 10 เปอร์เซ็นต์โดยน้ำหนักของตัวเร่งปฏิกิริยาต่อสารตั้งต้น เพื่อจะแก้ปัญหาในการนำตัวเร่งปฏิกิริยากลับมาใช้ใหม่ ตัวเร่งปฏิกิริยาควรอยู่ที่ตำแหน่งไอของสารตั้งต้น พบว่าแพลเลเดียมเอสบีเอ-15 เป็นตัวเร่งปฏิกิริยาที่ดีที่สุดสำหรับการผลิตแก๊สสังเคราะห์ (คาร์บอนมอนอกไซด์) สำหรับผลิตภัณฑ์ที่เป็นของเหลวกลั่นแล้ว ตัวเร่งปฏิกิริยาอะลูมิเนียมเอสบีเอ-15 และตัวเร่งปฏิกิริยา รูทีเนียมเอสบีเอ-15 จะให้ผลิตภัณฑ์เป็น 2-ไซโคลเพนเทน-1-โอิน และ 2-โพรพีน-1-ออล ซึ่งใช้เป็นสารขึ้นกลางในอุตสาหกรรมยาและเกษตรได้

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TUNYATORN TONGTOOLTUSH: CATALYTIC CRACKING OF GLYCEROL USING METAL-SUPPORTED SBA-15

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Mesoporous silica SBA-15 was synthesized by conventional hydrothermal method and using triblock P123 (poly(ethylene oxide)₂₀-poly(propylene oxide)₇₀-poly(ethylene oxide)₂₀) copolymer as a structure directing agent with gel composition 1.00 TEOS : 1.65×10^{-2} P123 : 6.95 HCl : 140 H₂O. The gel was crystallized at 100°C for 48 h. The Al-SBA-15 was synthesized by incorporated SBA-15 with aluminium *via* post synthesis. Additionally, the Ni, Pt, Pd and Ru metal on supported SBA-15 were prepared by aqueous wet impregnation method. The synthesized materials were characterized by X-ray powder diffraction, nitrogen sorption analysis, inductively coupled plasma-atomic emission, solid state ²⁷Al-nuclear magnetic resonance, scanning electron microscopy and transmission electron microscopy. Then pure glycerol and glycerol waste were utilized as starting materials to test catalytic cracking activities of Al-SBA-15 and metal supported SBA-15 catalysts. Reaction parameters such as catalyst type, reaction temperature, starting material to catalyst ratio, particle size of metal and catalyst position will be study. The optimum glycerol waste cracking condition was set to reaction temperature of 650°C and 10 wt% of catalyst based on starting material. In order to solve a problem of recycling catalyst, the catalyst should be placed in vapor phase of starting material. Pd-SBA-15 was discovered to be a good catalyst for synthetic gas (CO) production. For distilled liquid product, Al-SBA-15 and Ru-SBA-15 gave a high yield of 2-cyclopropen-1-one and 2-propen-1-ol which were important intermediate in pharmaceutical and agricultural fields.

Field of Study: Petrochemistry and Polymer Science Student's Signature T. Tongtooltush
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LIST OF ABBREVIATIONS

Å	Angstrom
a.u.	Arbitrary unit
BET	Brunauer-Emmett-Teller
BJH	Barret, Joyner, and Halenda
°C	Degree Celsius
cps	Counts per second
EDS	Energy dispersive X-ray spectrometer
GC	Gas chromatography
g	Gram (s)
h	Hour
ICP-AES	Inductively coupled plasma-atomic emission spectrometer
MAS-NMR	Magic angle spinning-nuclear magnetic resonance
MS	Mass spectroscopy
µm	Micrometer (s)
mg	Milligram (s)
ml	Milliliter (s)
min	Minute (s)
M	Molarity
nm	Nanometer (s)
NPs	Nanoparticle (s)
ppm	Part per million
%	Percentage
SEM	Scanning electron microscopy
TEM	Transmission electron microscopy
TEOS	Tetraethyl orthosilicate
XRD	X-ray diffraction