

แทรนส์เอสเทอร์ฟิเคชันของน้ำมันปาล์ม โดยใช้ตัวเร่งปฏิกิริยาอีทีเอส-10 ตัวเร่งปฏิกิริยาอีทีเอส-10  
ที่แทนที่ด้วยโลหะเจมาเนียม และ ตัวเร่งปฏิกิริยาอีทีเอส-10 ที่มีโซเดียม

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**TRANSESTERIFICATION OF PALM OIL USING ETS-10, ETGeS-10 AND  
Na-LOADED ETS-10 CATALYSTS**

**Miss Satima Saranark**

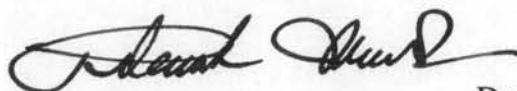
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                                  ETGeS-10 AND Na-LOADED ETS-10 CATALYSTS  
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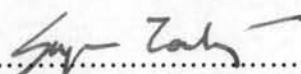
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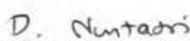


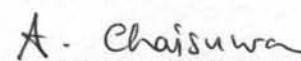
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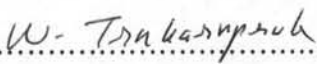
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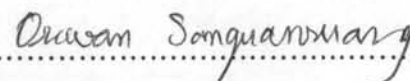
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สาธิตา สารระนาด : แทรนส์เอสเทอร์ฟิเคชันของน้ำมันปาล์มโดยใช้ตัวเร่งปฏิกิริยาอีทีเอส-10 ตัวเร่งปฏิกิริยาอีทีเอส-10 ที่แทนที่ด้วยโลหะเจมาเนียม และ ตัวเร่งปฏิกิริยาอีทีเอส-10 ที่มีโซเดียม (TRANSESTERIFICATION OF PALM OIL USING ETS-10, ETGeS-10 AND Na-LOADED ETS-10 CATALYSTS) อ. ที่ปรึกษา: ดร. ดวงกมล นันทศรี, อ. ที่ปรึกษาร่วม: ดร. อธิชา ฉายสุวรรณ, 98 หน้า.

ตัวเร่งปฏิกิริยาแอนเกลฮาร์ดทิทาโนซิลิเกต-10 (อีทีเอส-10) สังเคราะห์โดยการตกผลึกที่อุณหภูมิสูง ซึ่งใช้ไทเทเนียมไดออกไซด์ และ คอลลอยด์ซิลิกา หรือ สารละลายโซเดียมซิลิเกต เป็นแหล่งของไทเทเนียมและแหล่งของซิลิกาตามลำดับ ทำการสังเคราะห์โดยปราศจากสารอินทรีย์ต้นแบบและสารก่อผลึก สามารถสังเคราะห์ตัวเร่งปฏิกิริยาอีทีเอส-10 ที่แทนที่ด้วยโลหะเจมาเนียม (อีทีจีเอส-10) ได้โดยตรงที่อัตราส่วนโดยโมลของเจมาเนียมต่อไทเทเนียม 0.15 ถึง 0.5 นอกจากนี้ตัวเร่งปฏิกิริยาที่มีการปรับปรุงด้วยเบส สามารถเตรียมด้วยวิธีการแลกเปลี่ยนไอออนและการอิมเพกเนชันด้วยสารประกอบโซเดียม เพื่อเพิ่มความแรงและตำแหน่งของเบสของตัวเร่งปฏิกิริยา นำผลิตภัณฑ์ที่สังเคราะห์ได้มาตรวจสอบลักษณะเฉพาะด้วยเทคนิคการเลี้ยวเบนของรังสีเอกซ์ กล้องจุลทรรศน์แบบส่องกราด ดิฟฟิวส์เรฟเลกแทนซ์อัลตราไวโอเลต การคายรังสีจากอะตอมโดยใช้พลาสมาเหนี่ยวนำ การดูดกลืนรังสีของอะตอม และการดูดซับแก๊สไนโตรเจน ตัวเร่งปฏิกิริยาที่สังเคราะห์ได้ประกอบด้วยอีทีเอส-10 ที่มีรูปร่างคล้ายสี่เหลี่ยม และขนาดโพรงประมาณ 0.6 นาโนเมตร ปริมาณเจมาเนียมที่มากเกินไปทำให้เกิดการสลายตัวของโครงสร้างของตัวเร่งปฏิกิริยา ตัวเร่งปฏิกิริยาที่เตรียมได้ถูกนำไปประยุกต์กับปฏิกิริยาแทรนส์เอสเทอร์ฟิเคชันของน้ำมันปาล์มกับเมทานอล เพื่อผลิตเมทิลเอสเทอร์ของกรดไขมันหรือไบโอดีเซล ได้ศึกษาผลของภาวะต่างๆเช่น ปริมาณของตัวเร่งปฏิกิริยา อัตราส่วนโดยโมลของเมทานอลต่อน้ำมัน เวลาและอุณหภูมิในการเกิดปฏิกิริยา ได้วิเคราะห์ปริมาณไบโอดีเซลและกลีเซอรอลด้วยเทคนิคแก๊สโครมาโทกราฟี เมื่อใช้อีทีเอส-10ที่ผ่านการแลกเปลี่ยนไอออนและที่ทำอิมเพกเนชันด้วยสารประกอบโซเดียมเป็นตัวเร่งปฏิกิริยา ได้ปริมาณผลิตภัณฑ์เมทิลเอสเทอร์สูงสุดที่ 77.57% และ 79.80% ตามลำดับ ได้ศึกษาความว่องไวในการเร่งปฏิกิริยาของตัวเร่งปฏิกิริยาที่ผ่านการใช้งานแล้วและที่ปรับสภาพเหมือนใหม่อีกด้วย

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 ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

# # 4772512623: MAJOR PETROCHEMISTRY AND POLYMER SCIENCE

KEY WORD: ETS-10 / ETGeS-10 / TRANSESTERIFICATION / BIODIESEL

SATIMA SARANARK: TRANSESTERIFICATION OF PALM OIL  
USING ETS-10, ETGeS-10 AND Na-LOADED ETS-10 CATALYSTS.

THESIS ADVISOR: DUANGAMOL NUNTASRI, Ph.D. THESIS CO-  
ADVISOR: ATICHA CHAISUWAN, Ph.D., 98 pp.

Engelhard titanosilicate-10 (ETS-10) was synthesized via hydrothermal crystallization using  $\text{TiO}_2$  and colloidal silica or water glass solution as sources of Ti and Si, respectively. The synthesis was performed in the absence of organic template and seeds. Germanium substituted ETS-10 (ETGeS-10) can be directly synthesized at Ge/Ti mole ratio of 0.15 to 0.5. In addition, base-modified ETS-10 was able to be prepared by ion-exchange and impregnation methods with sodium compounds to increase the basic strength and basic site of catalyst. The synthesized products were characterized using XRD, SEM, DR-UV, ICP-AES, AAS and  $\text{N}_2$  adsorption techniques. The catalyst consists of ETS-10 with cubic-liked particles and pore size around 0.6 nm. The excess loading of germanium leads to the structural destruction of catalyst. All synthesized products were applied to transesterification reaction of palm oil with methanol to produce fatty acid methyl esters (biodiesel). The various reaction conditions such as catalyst amount, methanol to oil mole ratio including reaction time and temperature were studied. Biodiesel yield and glycerol were analyzed by GC technique. The highest transesterification activity was achieved when the Na-exchanged ETS-10 and Na-impregnated ETS-10 were used as catalyst, the methyl ester yield can be reached to 77.57% and 79.80%, respectively. Moreover, catalytic activities of regenerated and Na-reloaded catalysts were also investigated.

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## LIST OF ABBREVIATIONS

Btu	British thermal unit
K	Kelvin
°C	Degree Celsius
µm	Micrometer
nm	Nanometer
rpm	Rounds per minute
ppm	Part per million
M	Molar
Å	Angstrom unit
CCD	Couple charge detector
eV	Electron volt
R.T.	Room temperature
CS	Colloidal silica
WG	Water glass (sodium silicate solution)
XRD	X-ray diffraction
XPS	X-ray photoelectron spectroscopy
DR-UV	Diffuse reflectance-ultraviolet spectroscopy
CO <sub>2</sub> -TPD	Carbon dioxide-temperature programmed desorption
NMR	Nuclear magnetic resonance
GC	Gas chromatography
SEM	Scanning electron microscopy
SEM-EDX	Scanning electron microscopy-energy dispersive X-ray fluorescence
ETS-10	Engelhard titanosilicate-10
ETGeS-10	Germanium substituted Engelhard titanosilicate-10
ZSM-5	Zeolite Soconyl Mobil-5
h	Hour or hours
min	Minute or minutes
wt%	Percent by weight
MO	Methyl oleate
MP	Methyl palmitate

ML Methyl linoleate

MS Methyl stearate