

**PT/HY^{core}-PD/TIO₂^{shell} CATALYSTS FOR THE ONE-POT REACTION OF
JATROPHA OIL TO BIOJET FUEL**

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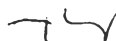
Thesis Title: Pt/HY^{core}-Pd/TiO₂^{shell} Catalysts for the One-pot Reaction of
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ABSTRACT

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Biojet fuel is obtained by the hydrodeoxygenation of triglycerides followed by hydrocracking and hydroisomerization reactions of the intermediate long chain hydrocarbons. In our previous studies, the catalysts for the two reactions were Pd/TiO₂ and Pt/HY respectively. In this research, the two catalysts were combined into Pt/HY^{core}-Pd/TiO₂^{shell} catalysts with different Pd/TiO₂^{shell} compositions (i.e. 31 %, 36 %, 44 %, and 57 wt%). The catalytic activities of the core-shell catalyst were tested in a continuous flow fixed bed reactor, compared with the pure Pt/HY, Pd/TiO₂ and physical mixture of the two catalysts. XRD, TEM, BET, TPD, TPR, and AAS results showed that Pt/HY^{core}-Pd/TiO₂^{shell} catalysts were successfully synthesized without losing Pt/HY and Pd/TiO₂ catalyst properties. The core-shell catalysts with Pd/TiO₂^{shell} of 31 %, 36 %, 44 %, and 57 % exhibited 100 % conversion of triglycerides into gasoline, jet, and diesel fuel range products while Pt/HY catalyst exhibited very low conversion of triglycerides with high oxygenate products and Pd/TiO₂ catalyst only converted to diesel range paraffin hydrocarbons. The products obtained over core-shell catalyst were shorter chain hydrocarbons compared to those obtained from the physical mixing catalyst due to its core-shell mechanism that jatropha oil was first deoxygenated in Pd/TiO₂^{shell} before further cracked in Pt/HY^{core}. Among all prepared catalysts, the core-shell catalyst with 36 % Pd/TiO₂^{shell} gave the highest biojet fuel yield of 40 % at TOS of 2 h.

บทคัดย่อ

วรชิต อำนวยพร : การผลิตน้ำมันเจ็ทจากน้ำมันสบู่ดำโดยใช้ตัวเร่งปฏิกิริยา $\text{Pt}/\text{HY}^{\text{core}}-\text{Pd}/\text{TiO}_2^{\text{shell}}$ ($\text{Pt}/\text{HY}^{\text{core}}-\text{Pd}/\text{TiO}_2^{\text{shell}}$ Catalysts for the One-pot Reaction of Jatropha Oil to Biojet Fuel) อ. ที่ปรึกษา : รศ. ดร. ศิริพร จงผาคิวุฒิ 67 หน้า

การผลิตน้ำมันเจ็ทที่มาจากพลังงานหมุนเวียน เริ่มจากน้ำมันที่มีส่วนผสมของไตรกลีเซอไรด์ผ่านปฏิกิริยาไฮโดรค็อกซิเจนชันตามด้วยปฏิกิริยาไฮโดรแครกกิง และ ปฏิกิริยาไฮโดรไอโซเมอไรเซชันของสารมัธยันตร์ที่เป็นไฮโดรคาร์บอนสายยาว การศึกษาที่ผ่านมาได้ใช้ตัวเร่งปฏิกิริยา Pd/TiO_2 และ Pt/HY ตามลำดับ งานวิจัยนี้ได้นำตัวเร่งปฏิกิริยาทั้งสองตัวมารวมเป็นตัวเร่งปฏิกิริยาคอร์เชลล์ในสัดส่วนต่างๆ ตัวเร่งปฏิกิริยาคอร์เชลล์ที่เตรียมขึ้นจะถูกนำมาทดสอบความว่องไวในการเร่งปฏิกิริยาจากน้ำมันสบู่ดำเป็นน้ำมันเจ็ท โดยใช้เครื่องปฏิกรณ์แบบเบดนิ่งชนิดไหลต่อเนื่อง ผลการวิเคราะห์ตัวเร่งปฏิกิริยาโดยใช้เทคนิค XRD, TEM, BET, TPD, TPR และ AAS แสดงให้เห็นว่าตัวเร่งปฏิกิริยาคอร์เชลล์ที่เตรียมขึ้นยังคงคุณสมบัติของตัวเร่งปฏิกิริยา Pt/HY และ Pd/TiO_2 ไว้ ตัวเร่งปฏิกิริยาคอร์เชลล์ที่สัดส่วนน้ำหนัก Pd/TiO_2 ที่ 31 %, 36 %, 44 % และ 57 % สามารถแปรสภาพน้ำมันสบู่ดำทั้งหมดเป็นไฮโดรคาร์บอนในช่วงจุดเดือดของน้ำมันแกโซลีน น้ำมันเจ็ท และ น้ำมันดีเซล ในขณะที่ตัวเร่งปฏิกิริยา Pt/HY แปรสภาพน้ำมันสบู่ดำได้ต่ำและได้ผลิตผลของออกซิเจนเป็นหลัก และตัวเร่งปฏิกิริยา Pd/TiO_2 ได้ผลิตผลไฮโดรคาร์บอน โฆตรงในช่วงน้ำมันดีเซล ผลิตผลไฮโดรคาร์บอนจากตัวเร่งปฏิกิริยาคอร์เชลล์โฆสั้นกว่าเมื่อเทียบกับผลิตผลจากตัวเร่งปฏิกิริยาที่ผสมทางกายภาพในสัดส่วนเดียวกันเพราะกลไกของคอร์เชลล์ เนื่องจากไตรกลีเซอไรด์ผ่านปฏิกิริยาไฮโดรค็อกซิเจนชันในตัวเร่งปฏิกิริยา Pd/TiO_2 ก่อนที่จะผ่านปฏิกิริยาไฮโดรแครกกิงในตัวเร่งปฏิกิริยา Pt/HY ในจำนวนตัวเร่งปฏิกิริยาที่ได้เตรียม ตัวเร่งปฏิกิริยาคอร์เชลล์ที่สัดส่วน Pd/TiO_2 36 % ได้ผลิตน้ำมันเจ็ทได้สูงสุดที่ 40 %

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