

HYDROGEN PRODUCTION FROM THE STEAM REFORMING OF
METHANOL OVER Au/Fe₂O₃-CeO₂ CATALYSTS



Wissanu Shuenka

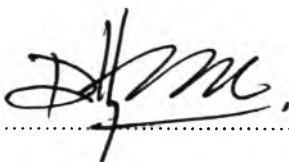
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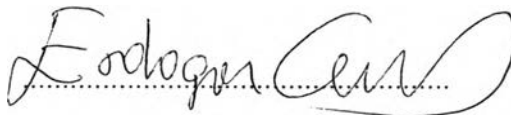
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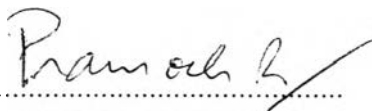
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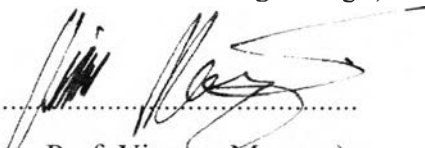

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ABSTRACT

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Wissanu Shuenka: Hydrogen Production from the Steam Reforming of Methanol over Au/Fe₂O₃-CeO₂ Catalysts.

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Steam reforming of methanol has been performed on a variety of supported Au catalysts. In this work, the catalysts were prepared by deposition-precipitation (DP) and their catalytic activity were studied in a micro-reactor with various reaction temperatures ranging from 250 to 450°C under atmospheric pressure. A feed of 1.5 ml/hour of the mixture of distilled water and methanol over the supported Au catalyst was used. Among the catalysts tested, the 1%Au/Fe₂O₃-CeO₂(1:8) gave a methanol conversion of 95% at 350°C, which was higher than those over Au/CeO₂ and Au/Fe₂O₃ under the same reaction conditions. The catalysts were characterized for their morphology, size of the Au particle, surface area, and reduction behavior by XRD, TEM, BET, and TPR, respectively. The XRD result of the 1%Au/Fe₂O₃-CeO₂(1:8) revealed that there is no evidence of gold peaks, whereas in the TEM image, 3 to 4 nm sized gold particles were clearly observed. It was found that the addition of a small amount of Fe resulted in a remarkable increase in the surface area of the catalyst. In addition, the TPR profiles indicated that the combination of Fe₂O₃ and CeO₂ significantly influences the reduction temperature of the catalysts.

บทคัดย่อ

วิทยุ ชื่นคำ : กระบวนการผลิตก๊าซไฮโดรเจนจากปฏิกิริยาเปลี่ยนรูปเมทานอลด้วยไอน้ำโดยใช้ตัวเร่งปฏิกิริยาทองบนซีเรียออกไซด์ผสมเฟอร์รัสออกไซด์ (Hydrogen Production from the Steam Reforming of Methanol over Au/Fe₂O₃-CeO₂) อ. ที่ปรึกษา : ผศ.ดร. อาภาณี เหลืองนฤมิตชัย ศ.ดร. เอโดแกน กุลารี่

ในงานวิจัยนี้ศึกษาปฏิกิริยาการเปลี่ยนรูปเมทานอล โดยใช้ไอน้ำด้วยตัวเร่งปฏิกิริยาทองบนตัวรองรับชนิดต่างๆ ซึ่งตัวเร่งปฏิกิริยาจะเตรียมโดยใช้วิธี Deposition-precipitation และนำไปศึกษาความสามารถในการเร่งปฏิกิริยาในเตาปฏิกรณ์ขนาดเล็ก อุณหภูมิที่ใช้ในการศึกษาอยู่ในช่วง 250 ถึง 450 องศาเซลเซียส ภายใต้สภาวะความดันปกติ โดยใช้สารตั้งต้นเป็นน้ำกลั่นผสมเมทานอลทำปฏิกิริยาบนตัวเร่งปฏิกิริยาทอง ผลการศึกษาพบว่าตัวเร่งปฏิกิริยา 1%Au/Fe₂O₃-CeO₂(1:8) ให้ผลการเปลี่ยนแปลงเมทานอล 95% ที่อุณหภูมิ 350 องศาเซลเซียส ซึ่งให้ค่ามากกว่า 1%Au/CeO₂ และ 1%Au/Fe₂O₃ ที่สภาวะการเกิดปฏิกิริยาเดียวกัน นอกจากนั้นทำการวิเคราะห์คุณลักษณะของตัวเร่งปฏิกิริยา โดยใช้เทคนิค XRD, TEM, BET และ TPR จากผลการวิเคราะห์โดยใช้ XRD พบว่าตัวเร่งปฏิกิริยา 1%Au/Fe₂O₃-CeO₂ ไม่ปรากฏว่ามีโครงสร้างผลึกของทองเป็นองค์ประกอบ ในขณะเดียวกัน จากผลการวิเคราะห์ด้วย TEM พบว่า ขนาดของทองมีขนาด 3 ถึง 4 นาโนเมตร จากการศึกษาพบว่าการเพิ่มปริมาณ Fe เล็กน้อยในตัวรองรับจะส่งผลให้พื้นที่ผิวของตัวรองรับเพิ่มขึ้นอย่างเห็นได้ชัด ผลของ TPR พบว่า การผสมกันของ Fe₂O₃ และ CeO₂ นั้นส่งผลต่อ อุณหภูมิการรีดักชันของตัวเร่งปฏิกิริยา นอกจากนั้นตัวเร่งปฏิกิริยายังแสดงความสามารถในการเร่งปฏิกิริยาได้ต่อเนื่องเป็นระยะเวลา 24 ชั่วโมงของการทดลอง

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