

**HYDROGEN PRODUCTION FROM STEAM REFORMING OF METHANE
USING NI-SUPPORTED KL ZEOLITE CATALYSTS**

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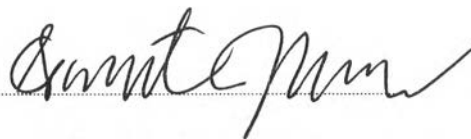
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ABSTRACT

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In addition to its use for industrial feed, hydrogen has received a great deal of attention in fuel cell applications with the goal of reducing negative impacts on the environment. Steam reforming of methane using supported Ni catalysts is a major process in hydrogen production. In this work, the steam reforming of methane using Ni supported on KL zeolite catalysts was studied. The catalysts were prepared by the incipient wetness impregnation method (IWI) and characterized using BET, XRD, TPR and TPO techniques. The main purpose of this work was to study the effects of Ni loading, ceria promoter and the H₂O/CH₄ ratio over Ni supported on KL zeolites. A comparison study between Ni/KL zeolite and Ni/ α -alumina catalysts was also studied for the effect of the H₂O/CH₄ ratio. Among the catalysts examined, 7%Ni-3%Ce/KL zeolite exhibited the best catalytic activity and stability. The addition of a ceria promoter enhanced Ni dispersion and reduced carbon deposition on the catalyst. At a H₂O/CH₄ ratio of 1, methane conversion of KL zeolite catalyst slightly decreased with time on stream while at H₂O/CH₄ ratios of 2 and 3, methane conversion remained constant. KL zeolite catalyst was comparable to commercial catalysts in terms of catalytic activity and stability.

บทคัดย่อ

ณัฐพงศ์ เสนาธิบดี: การผลิตก๊าซไฮโดรเจนด้วยปฏิกิริยาการรีฟอร์มก๊าซมีเทนด้วยไอน้ำ โดยใช้ตัวเร่งปฏิกิริยานิกเกิลบนเคแอลซีโอไลต์ (Hydrogen Production from Steam Reforming of Methane Using Ni-Supported on KL Zeolite Catalysts) อ. ที่ปรึกษา: ดร. อาภาณี เหลืองนฤมิตชัย และ ดร. ศิริรัตน์ จิตการคำ 53 หน้า ISBN 974-9651-09-x

นอกจากการใช้เป็นสารตั้งต้นในกระบวนการผลิตสารเคมีแล้ว ก๊าซไฮโดรเจนยังได้รับความสนใจในการใช้เป็นเชื้อเพลิงในเทคโนโลยีฟิวเอลเซลล์ (Fuel cell) ปฏิกิริยาการรีฟอร์มก๊าซมีเทนด้วยไอน้ำโดยเป็นปฏิกิริยาหลักในการผลิตก๊าซไฮโดรเจน ในงานวิจัยนี้ ได้ทำการศึกษาปฏิกิริยาการรีฟอร์มก๊าซมีเทนด้วยไอน้ำโดยใช้ตัวเร่งปฏิกิริยานิกเกิลบนเคแอลซีโอไลต์ (KL zeolite) ซึ่งเตรียมโดยวิธีอิมเพรกเนชัน (Impregnation method) และได้ทำการทดสอบคุณสมบัติของตัวเร่งปฏิกิริยาโดยใช้ BET, XRD, TPR และ TPO วัตถุประสงค์หลักในงานวิจัยนี้ เพื่อศึกษาผลกระทบของปริมาณนิกเกิลที่ใช้ สารปรับปรุงคุณภาพของตัวเร่งปฏิกิริยา อัตราส่วนของปริมาณน้ำต่อก๊าซมีเทน และยังสามารถศึกษาเปรียบเทียบคุณสมบัติระหว่างตัวเร่งปฏิกิริยานิกเกิลบนเคแอลซีโอไลต์ และตัวเร่งปฏิกิริยานิกเกิลบนแอลฟาอลูมินา จากการทดลองพบว่า ปริมาณนิกเกิลบนเคแอลซีโอไลต์ที่เหมาะสมคือ 7% โดยน้ำหนัก ในการเติมสารปรับปรุงคุณภาพคือ ซีเรีย พบว่า สามารถช่วยในการเพิ่มการกระจายตัวของนิกเกิล และลดการสะสมตัวของคาร์บอนบนตัวเร่งปฏิกิริยา แต่ไม่สามารถปรับปรุงด้านการเกิดปฏิกิริยาของตัวเร่งปฏิกิริยา ในการศึกษาผลกระทบของอัตราส่วนของปริมาณน้ำต่อก๊าซมีเทนพบว่า ที่อัตราส่วนของน้ำต่อก๊าซมีเทนเท่ากับ 1 ตัวเร่งปฏิกิริยามีการเสื่อมสภาพเมื่อเวลาในการทำปฏิกิริยาเพิ่มขึ้น แต่ที่อัตราส่วนของน้ำต่อก๊าซมีเทนเท่ากับ 2 และ 3 พบว่าไม่เกิดการเสื่อมสภาพของตัวเร่งปฏิกิริยา ในการศึกษาเปรียบเทียบคุณสมบัติในการเร่งปฏิกิริยา พบว่าตัวเร่งปฏิกิริยานิกเกิลบนเคแอลซีโอไลต์ มีคุณสมบัติในการเร่งปฏิกิริยา และอายุการใช้งานที่ดีเมื่อเปรียบเทียบกับตัวเร่งปฏิกิริยาทางการค้า

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