

**HYDROGEN PRODUCTION BY AUTOTHERMAL SYSTEM
OVER Ce/Zr MIXED OXIDES**



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จิตติพร จันทร์ดี : การศึกษาการผลิตไฮโดรเจนโดยระบบความร้อนที่ได้ด้วยตัวเองโดยใช้ตัวเร่งปฏิกิริยา ซีเรียม/เซอร์โคเนียม ออกไซด์ (Hydrogen Production by Autothermal System over Ce/Zr mixed oxides) อาจารย์ที่ปรึกษา: ศ. โจอีสานเนต ชวางค์, ผศ.ดร. ชีรศักดิ์ ฤกษ์สมบูรณ์ และ ผศ.ดร. วิษณุ มีอยู่ 97 หน้า ISBN 974-13-0685-7

ระบบความร้อนที่ได้ด้วยตัวเองซึ่งเป็นระบบที่รวมเอาระบบ partial oxidation และระบบ steam reforming ไว้ในเครื่องปฏิกรณ์เดียวกัน เป็นอีกทางเลือกหนึ่งในการผลิตก๊าซไฮโดรเจน ความร้อนที่เกิดจากระบบ partial oxidation จะส่งไปยังระบบ steam reforming ในขณะเดียวกัน คาร์บอนที่เกิดขึ้นจะถูกกำจัดโดยก๊าซออกซิเจน เนื่องจาก ซีเรียม/เซอร์โคเนียมออกไซด์ เป็นตัวเร่งปฏิกิริยาที่ส่งเสริมปฏิกิริยา steam reforming และ water-gas shift ในขณะเดียวกันก็เร่งปฏิกิริยา coke gasification ซึ่งลดการเกิดคาร์บอน ดังนั้นซีเรียม/เซอร์โคเนียมออกไซด์ จึงเหมาะที่จะเป็นตัวเร่งปฏิกิริยาสำหรับระบบความร้อนที่ได้ด้วยตัวเอง ในงานวิจัยนี้ ซีเรียม/เซอร์โคเนียมออกไซด์ ถูกเตรียมโดยวิธี sol-gel การศึกษานี้ได้ศึกษาผลกระทบของ อัตราส่วนระหว่างซีเรียมและเซอร์โคเนียม, ความเข้มข้นของยูเรีย, วิธีการอบแห้ง และ การเติมนิกเกิล ต่อคุณสมบัติของซีเรียม/เซอร์โคเนียมออกไซด์ นอกจากนี้ตัวเร่งปฏิกิริยาจะถูกวิเคราะห์โดยวิธี BET, SEM, XRD และ FT-Raman spectra สมรรถนะของตัวเร่งปฏิกิริยาจะถูกทดสอบโดยปฏิกิริยา iso-octane oxidation ที่อัตราส่วนออกซิเจนและคาร์บอน ที่ 1 จากการทดลองพบว่า $Ce_{0.75}Zr_{0.25}O_2$ มีประสิทธิภาพดีที่สุดสำหรับปฏิกิริยา iso-octane oxidation จากการศึกษาในระบบระบบความร้อนที่ได้ด้วยตัวเองบน $5\%Ni/Ce_{0.75}Zr_{0.25}O_2$ พบว่า อัตราส่วนระหว่างไฮโดรเจนและคาร์บอนนอกไซด์จะเพิ่มขึ้นเมื่อเพิ่มความเข้มข้นของไอน้ำและอัตราส่วนออกซิเจนต่อคาร์บอน

ABSTRACT

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An autothermal system, which is a combination of the partial oxidation and steam reforming processes operated simultaneously in a single reactor, can be an alternative to the hydrogen production. Heat dissipated from partial oxidation will be provided for steam reforming whereas coke formation can be eliminated in the presence of O_2 . Since Ce/Zr mixed oxides were found to promote the steam reforming and water-gas shift reaction as well as coke gasification, this makes it possible to exploit such mixed oxides in the autothermal system. In this work, Ce/Zr mixed oxides were prepared by sol-gel technique. The effects of Ce:Zr molar ratios, urea concentrations, drying methods and Ni loading were investigated on the catalytic properties of Ce/Zr mixed oxides. The catalysts were characterized using a BET surface area measurement, SEM, XRD and FT-Raman spectra. The catalyst performance was tested via iso-octane oxidation at a constant O_2/C ratio of 1. It was found that $Ce_{0.75}Zr_{0.25}O_2$ exhibited the highest catalytic activity. The $Ce_{0.75}Zr_{0.25}O_2$ dried under supercritical conditions has bigger pore sizes and higher pore volumes than that dried by conventional method. For autothermal system studies, the effects of H_2O/C and O_2/C ratios on 5%Ni/ $Ce_{0.75}Zr_{0.25}O_2$ can be served in which H_2/CO ratio increases with increasing H_2O/C and O_2/C ratios.

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