

**HYDROGEN PRODUCTION FROM WATER SPLITTING UNDER VISIBLE
LIGHT IRRADIATION USING SENSITIZED MESOPOROUS-ASSEMBLED
TiO₂-SiO₂ MIXED OXIDE PHOTOCATALYSTS**

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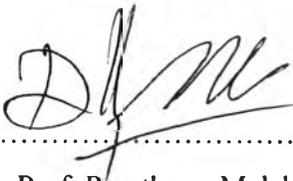
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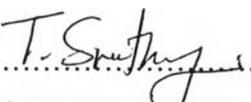
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บทคัดย่อ

นที รุ่งเจริญถาวร: การผลิตไฮโดรเจนจากการแตกโมเลกุลของน้ำภายใต้สภาวะที่มีแสงในช่วงตามองเห็นโดยใช้ตัวเร่งปฏิกิริยาออกไซด์ผสมระหว่างไททาเนียมไดออกไซด์และซิลิคอนไดออกไซด์ที่เกาะตัวกันจนมีรูพรุนขนาดเมโซพอร์ที่ถูกกระตุ้น (Hydrogen Production from Water Splitting under Visible Light Irradiation Using Sensitized Mesoporous-Assembled TiO₂-SiO₂ Mixed Oxide Photocatalysts) อ. ที่ปรึกษา: ผศ. ดร. ธรรมบุญ ศรีทวงศ์ และ ศ. ดร. สุเมธ ชวเดช 94 หน้า

ในปัจจุบันแหล่งพลังงานทางเลือกใหม่ โดยเฉพาะอย่างยิ่งไฮโดรเจน ถูกพิจารณาว่าเป็นแหล่งพลังงานในอุดมคติในอนาคต ปฏิกิริยาการแตกโมเลกุลของน้ำโดยใช้ตัวเร่งปฏิกิริยาแบบใช้แสงร่วมเป็นกระบวนการในอุดมคติในการผลิตไฮโดรเจน โดยการใช้แสงเป็นแหล่งพลังงานและใช้น้ำเป็นสารตั้งต้น งานวิจัยนี้มุ่งเน้นการผลิตไฮโดรเจนจากกระบวนการแตกโมเลกุลของน้ำด้วยปฏิกิริยาแบบใช้แสงร่วมภายใต้สภาวะที่มีแสงในช่วงที่ตามองเห็น โดยใช้ตัวเร่งปฏิกิริยาแบบใช้แสงร่วมชนิดออกไซด์ผสมระหว่างไททาเนียมไดออกไซด์และซิลิคอนไดออกไซด์ที่มีการเติมตัวเร่งปฏิกิริยาร่วมโลหะแบบเดี่ยวของแพลทินัม และโลหะแบบผสมของแพลทินัมและทอง โดยมีการกระตุ้นด้วยสีข้อม โดยตัวเร่งปฏิกิริยาแบบใช้แสงร่วมชนิดออกไซด์ผสมดังกล่าวที่มีการกระตุ้นโดยโมลของไททาเนียมไดออกไซด์ต่อซิลิคอนไดออกไซด์ที่ค่าต่างๆนี้ถูกสังเคราะห์ขึ้นโดยกระบวนการ โสเดเจลควบคู่กับการใช้สารลดแรงตึงผิวเป็นสารต้นแบบ โดยได้ศึกษาถึงตัวแปรต่างๆที่มีผลต่อประสิทธิภาพในการเร่งปฏิกิริยาแบบใช้แสงร่วมของตัวเร่งปฏิกิริยา ได้แก่ อุณหภูมิในการแคลไซน์ องค์ประกอบเฟสของตัวเร่งปฏิกิริยา และการเติมแพลทินัมและทอง จากผลการทดลองพบว่าในกรณีที่ไม่มีการเติมโลหะเป็นตัวเร่งปฏิกิริยาร่วม ตัวเร่งปฏิกิริยาแบบใช้แสงร่วมที่มีค่าอัตราส่วนโดยโมลของไททาเนียมไดออกไซด์ต่อซิลิคอนไดออกไซด์ ที่ค่า 97 ต่อ 3 และแคลไซน์ที่อุณหภูมิ 500 องศาเซลเซียส มีประสิทธิภาพในการผลิตไฮโดรเจนมากที่สุด นอกจากนี้การเติมโลหะแบบเดี่ยวของแพลทินัม และโลหะแบบผสมของแพลทินัมและทอง ในปริมาณที่เหมาะสมลงบนพื้นผิวของตัวเร่งปฏิกิริยาแบบใช้แสงร่วมด้วยวิธีการบีดเกาะด้วยกระบวนการเคมีโดยใช้แสงร่วม ถูกพบว่าช่วยเพิ่มประสิทธิภาพการผลิตไฮโดรเจนของตัวเร่งปฏิกิริยาแบบใช้แสงร่วมชนิดออกไซด์ผสมระหว่างไททาเนียมไดออกไซด์และซิลิคอนออกไซด์อย่างมาก

ABSTRACT

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Alternative energy resources, especially hydrogen, are now being recognized as an ideal energy source for the future. The photocatalytic water splitting is an ideal method for producing hydrogen by using solar light as the energy source and water as the feedstock. This work focused on hydrogen production from photocatalytic water splitting under visible light irradiation using Eosin Y-sensitized mesoporous-assembled TiO₂-SiO₂ mixed oxide photocatalysts loaded with monometallic and bimetallic Pt-Au cocatalysts, of which the mesoporous-assembled TiO₂-SiO₂ mixed oxide photocatalyst with various TiO₂-to-SiO₂ molar ratios were synthesized by a sol-gel process with the aid of a structure-directing surfactant. Various parameters affecting the photocatalytic activity, including calcination temperature, phase composition, and Pt and Au loadings, were investigated. The experimental results showed that without metal loading, the TiO₂-SiO₂ photocatalyst with a TiO₂-to-SiO₂ molar ratio of 97:3 calcined at 500 °C provided the maximum photocatalytic hydrogen production activity. Moreover, the monometallic and bimetallic Pt-Au loadings with suitable contents by the photochemical deposition method were found to greatly enhance the photocatalytic activity of the TiO₂-SiO₂ photocatalyst.

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