

OXIDATION OF ETHYLENE OVER Au/TiO₂ CATALYSTS

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ABSTRACT

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Gold is generally an inert metal but it has recently been discovered that gold on titania is an active catalyst for CO oxidation and propylene epoxidation reactions. The catalytic activity of gold, depending upon gold particle size and type of support material has been known. The objective of this research was to investigate the catalytic activity of an ethylene oxidation reaction under the various oxygen concentrations over Au catalysts on two different types of titania which are commercial titania and titania nanotubes (TNT) synthesized by the hydrothermal treatment at 423 K. The addition of gold on commercial TiO₂ increased ethylene conversion substantially under stoichiometric and excess oxygen conditions. For Au/commercial TiO₂, the catalytic activity was found to depend upon calcination temperature and the optimum calcination temperatures were around 573 K and 473 K under the stoichiometric and excess oxygen conditions, respectively. On the contrary, gold impregnated on TNT did not improve the catalytic activity and there were no obvious differences in the catalytic activity of Au/TNT at different calcination temperatures.

บทคัดย่อ

ชื่อ นามสกุล : การเกิดปฏิกิริยาออกซิเดชันของเอทิลีนโดยใช้ตัวเร่งปฏิกิริยาทองบนตัวรองรับไททาเนีย (Oxidation of Ethylene over Au/TiO₂ Catalysts) อ. ที่ปรึกษา: รศ.ดร. สุเมธ ชวเชช และ รศ.ดร.วิษณุ มีอยู่ 60 หน้า ISBN 974-9937-50-3

โดยทั่วไปแล้ว ทองจัดอยู่ในประเภทโลหะเฉื่อยซึ่งไม่ว่องไวในการเกิดปฏิกิริยา แต่ไม่นานมานี้มีการค้นพบว่า ทองบนตัวรองรับไททาเนียสามารถใช้เป็นตัวเร่งปฏิกิริยาในปฏิกิริยาออกซิเดชันของคาร์บอนไดออกไซด์ และปฏิกิริยาอีพอกซิเดชันของโพรพิลีนได้เป็นอย่างดี นอกจากนี้เป็นที่รู้กันดีว่า ความว่องไวในการเร่งปฏิกิริยาของทองขึ้นอยู่กับขนาดของอนุภาคทอง และชนิดของตัวรองรับ ดังนั้นจุดประสงค์ของงานวิจัยชิ้นนี้คือ ศึกษาความว่องไวในการเร่งปฏิกิริยาออกซิเดชันของเอทิลีน ภายใต้สภาวะของออกซิเจนที่มีความเข้มข้นต่างกัน ด้วยตัวเร่งปฏิกิริยาทองบนตัวรองรับสองชนิดคือ ไททาเนียตามท้องตลาดและไททาเนียแบบท่อขนาดนาโน ซึ่งได้จากการสังเคราะห์ด้วยวิธีไฮโดรเทอร์มอล ที่อุณหภูมิ 150 องศาเซลเซียส การเติมตัวเร่งปฏิกิริยาทองลงบนตัวรองรับไททาเนียตามท้องตลาด สามารถเพิ่มค่าความเปลี่ยนแปลงได้อย่างมาก ภายใต้สภาวะของออกซิเจนที่เพียงพอและเกินพอในการเกิดปฏิกิริยา ความว่องไวของตัวเร่งปฏิกิริยาทองบนตัวรองรับไททาเนียตามท้องตลาดนั้น ยังขึ้นอยู่กับอุณหภูมิการเผา ซึ่งอุณหภูมิการเผาที่เหมาะสมภายใต้สภาวะออกซิเจนที่พอเพียงและเกินพอในการเกิดปฏิกิริยาคือ 573 เคลวิน และ 473 เคลวิน ตามลำดับ ในทางตรงกันข้ามตัวเร่งปฏิกิริยาทองที่ถูกเตรียมโดยวิธีการฝังตัวบนตัวรองรับไททาเนียแบบท่อขนาดนาโน ไม่ได้ช่วยให้ตัวเร่งปฏิกิริยามีความว่องไวมากขึ้น นอกจากนี้เมื่อตัวเร่งปฏิกิริยาถูกเผาที่อุณหภูมิสูงต่างกัน ไม่พบความแตกต่างของความว่องไวในการเกิดปฏิกิริยาอีกด้วย

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