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DEFECT STRUCTURE CONTROLLING ON TiO_2 NANOCRYSTAL
AND ITS APPLICATIONS

Mr. Kongkiat Suriye

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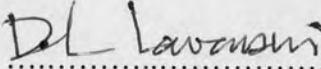
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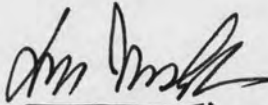
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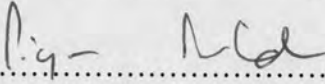
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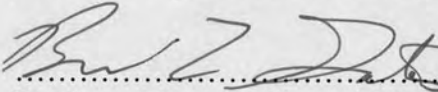
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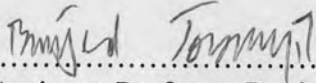
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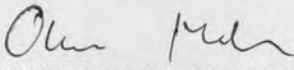

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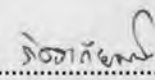
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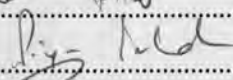
งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาทำความเข้าใจถึงการควบคุมความบกพร่องบนพื้นผิวของผลึกไทเทเนียมระดับนาโนเมตร และการประยุกต์ใช้งานทางด้านตัวเร่งปฏิกิริยาของมัน นอกจากนี้ ยังมุ่งเน้นเพื่อการศึกษาผลกระทบของความบกพร่องที่มีต่อความเสถียรทางความร้อนของไทเทเนียมระดับนาโนเมตรอีกด้วย ในงานวิจัยนี้ การศึกษาได้มุ่งเน้นไปบนไทเทเนียมที่มีโครงสร้างแบบอนาเทส ซึ่งมีความสำคัญอย่างมากต่อการนำไปประยุกต์ใช้งานในด้านต่างๆ โดยในส่วนของ การควบคุมความบกพร่องบนพื้นผิวนั้น ในงานวิจัยนี้ได้ประสบความสำเร็จในการควบคุมความบกพร่องบนพื้นผิวของผลึกไทเทเนียมในโครงสร้างแบบอนาเทส ภายในขั้นตอนเดียวกับการสร้างผลึกไทเทเนียมระดับนาโนเมตรด้วยวิธีการ โซล-เจล ซึ่งเป็นแนวคิดใหม่ที่สามารถสร้างความบกพร่องบนพื้นผิวของไทเทเนียมบนโครงสร้างแบบอนาเทส โดยใช้ขั้นตอนและพลังงานน้อยกว่าวิธีที่ถูกละทิ้งโดยทั่วไป หลังจากนั้นผลึกดังกล่าวได้ถูกนำไปศึกษาเพื่อประยุกต์ใช้งานเป็นตัวเร่งปฏิกิริยาดำเนินการ ซึ่งพบว่าผลึกที่มีปริมาณความบกพร่องบนพื้นผิวสูง จะช่วยยับยั้งการรวมตัวกลับของอิเล็กตรอนและช่องว่างที่เกิดขึ้นมาจากการกระตุ้นด้วยแสง และส่งผลให้ผลึกดังกล่าวมีประสิทธิภาพในปฏิกิริยากำจัดเอทิลีนได้สูงขึ้น ยิ่งไปกว่านั้นด้วยการนำไทเทเนียมที่มีความบกพร่องบนผลึกดังกล่าวไปใช้เป็นตัวรองรับตัวเร่งปฏิกิริยาโคบอลต์ พบว่าความบกพร่องดังกล่าวช่วยในการยึดโคบอลต์ไว้บนตัวรองรับ และส่งผลให้โคบอลต์มีการกระจายตัวได้ดียิ่งขึ้น และยังช่วยในการยับยั้งการเกิดสารประกอบเชิงซ้อนระหว่างตัวเร่งปฏิกิริยาและตัวรองรับได้อีกด้วย ซึ่งจะส่งผลท้ายสุดให้ตัวเร่งปฏิกิริยาบนตัวรองรับดังกล่าวมีประสิทธิภาพในปฏิกิริยา CO -hydrogenation ได้ดีมากยิ่งขึ้น นอกจากการนำไปประยุกต์ใช้งานแล้วนั้น ในงานวิจัยยังได้ศึกษาถึงผลกระทบของปริมาณความบกพร่องบนพื้นผิวของผลึกระดับนาโนเมตรที่มีต่ออัตราการโตของผลึกดังกล่าว ซึ่งพบว่า ปริมาณความบกพร่องสามารถถูกสร้างบนพื้นผิวของผลึกไทเทเนียมระดับนาโนเมตรได้ตามต้องการ โดยปราศจากการเพิ่มขึ้นของอัตราการโตของผลึก ในส่วนสุดท้ายได้ทำการศึกษาเพื่อตรวจวัดและทำความเข้าใจถึงการดำเนินงานและคุณลักษณะของความบกพร่องบนพื้นผิวของผลึกโดยผ่านการตีความด้วยโลหะคาร์บอนิระดับอะตอม ซึ่งทำให้สามารถเข้าใจการทำงานของความบกพร่องบนพื้นผิวของผลึกได้ลึกซึ้งยิ่งขึ้นอีกด้วย

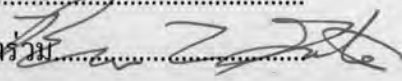
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KONGKIAT SURIYE: DEFECT STURCTURE CONTROLLING ON TiO_2 NANOCRYSTAL AND ITS APPLICATIONS. THESIS ADVISOR: PROF. PIYASAN PRASERTHDAM, Dr.Ing., THESIS CO-ADVISOR: PROF. BRUCE C. GATES, Ph.D., 202 pp.

The objectives of this work are the study for understanding surface defect (Ti^{3+}) of TiO_2 nanocrystal in anatase phase in the points of controlling, probing, and investigating its effect on the thermal stability, photoactivity, metal-support strong interaction, and the forming of metal-support compound. In this work, the surface defect (Ti^{3+}) has been successfully controlled on TiO_2 nanocrystal at the same time with the preparation of anatase via sol-gel technique. This new method consumes less step and energy than the common technique. For the application of TiO_2 having different amount of surface defect on the photocatalysis, it was found that the increase in number of surface defect can enhance the photoactivity of TiO_2 nanocrystal because it can inhibit the recombination process between photo-electron and hole generated after UV irradiation. For another application of TiO_2 nanocrystal as a support of cobalt, it can be concluded that the increase in number of surface defect (Ti^{3+}) can enhance the cobalt dispersion on TiO_2 support and also inhibit the formation of Co-SCF after standard reduction which led to increase in activity of cobalt for CO-hydrogenation. In this work, moreover, the effect of surface defect on the thermal stability was also investigated via the Piyasan's equation showing that the increase in number of surface defect have no effect on the rate of crystal growth and the surface defect can be created as mush as required. In the last part, the probing surface defect by using metal carbonyls in the atom level was also studied. It can monitor the behavior of surface defect and make a deeply understanding over it.

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