

**PHOTOCATALYTIC DEGRADATION OF ACID ORANGE 7 OVER  
p – n TYPE PHOTOCATALYSTS UNDER ILLUMINATION AND  
ABSENCE OF LIGHT**

Ummara Sittiwong

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**By:** Ummara Sittiwong  
**Program:** Petroleum Technology  
**Thesis Advisors:** • Assoc. Prof. Pramoch Rangsunvigit  
Asst. Prof. Pailin Ngaotranwiwat

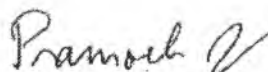
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..... College Dean  
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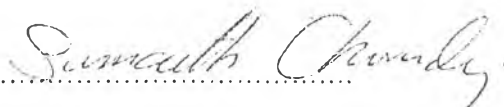
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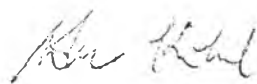
.....  
(Assoc. Prof. Pramoch Rangsunvigit)



.....  
(Asst. Prof. Pailin Ngaotranwiwat)



.....  
(Prof. Sumaeth Chavadej)



.....  
(Dr. Natthakorn Kraikul)

## ABSTRACT

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Ummara Sittiwong: Photocatalytic Degradation of Acid Orange 7 over p-n Type Photocatalysts under Illumination and Absence of Light.

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Nowadays, a large amount of dyewastes, mainly synthetic dyes is continuously released by the textile industry. The component of this dyes, especially acid orange 7 (AO7), can block a sunlight penetration and oxygen dissolution in water, leading to seriously environmental and health problems. For removal of dyewastes, photocatalysis is one of the most valuable techniques. Although it is a great application in dyewaste treatment, the photocatalytic reaction could not take place without illumination. For that reason, it is of interest to further improve the photocatalytic activity without illumination. To achieve that, the p-n junction semiconductor is used as a model to store the oxidation energy when there is no illumination. A p-n catalyst was formed by doping n-type  $\text{TiO}_2$  with p-type ZnO and p-type  $\text{V}_2\text{O}_5$  as an oxidation energy storage catalyst. The sol-gel method was used to form a bilayer film catalyst ( $\text{ZnO}/\text{TiO}_2$  and  $\text{V}_2\text{O}_5/\text{TiO}_2$ ) coated on a glass slide substrate. The calcination temperature effect of ZnO and  $\text{V}_2\text{O}_5$  on the photocatalytic activity was investigated, and the ZnO and  $\text{V}_2\text{O}_5$  loading was also studied. The result showed that the highest degradation with 300ZnO/ $\text{TiO}_2$  film, at 300 °C calcination temperature of ZnO particles, was about 32.5% with illumination and 2.4% with no illumination. Furthermore, the photocatalytic activity was increased with increasing in the ZnO loading and reached the maximum at 98 wt%. In contrast, the photocatalytic activity of the  $\text{V}_2\text{O}_5/\text{TiO}_2$  film hardly affected the AO7 degradation.

## บทคัดย่อ

อัมรา สิทธิรงค์ : การสลายตัวของสีย้อมเอซิดในสภาวะไร้แสง โดยใช้ฟิล์มสองชั้นของ ซิงค์ออกไซด์และ วาเนเดียม ไดออกไซด์บนไทเทเนียมไดออกไซด์ (Photocatalytic Degradation of Acid Orange 7 over p-n Type Photocatalysts under Illumination and Absence of Light) อ. ที่ปรึกษา: รศ. ดร. ปราโมช รังสรรค์วิจิตร และ ผศ. ดร. ไพลิน เภาตระการ วิทยณ์ 60 หน้า

ในปัจจุบันอุตสาหกรรมสิ่งทอได้ปล่อยน้ำเสียจากสีย้อม โดยเฉพาะสีย้อมสังเคราะห์ลงสู่แหล่งน้ำเป็นจำนวนมาก สีย้อมสังเคราะห์ที่นิยมใช้คือ สีย้อมเอซิด Acid Orange 7 (AO7) โดยส่วนประกอบของสีย้อมขัดขวางการส่องผ่านของแสงอาทิตย์และการละลายของออกซิเจนในน้ำ ส่งผลให้เกิดปัญหาสิ่งแวดล้อมและสุขภาพต่อมนุษย์และสิ่งมีชีวิตในน้ำ เพื่อที่จะกำจัดน้ำเสียจากสีย้อมเหล่านี้ การสลายตัวด้วยแสงเป็นอีกกระบวนการหนึ่งที่มีประโยชน์อย่างมาก ถึงแม้ว่าการสลายตัวด้วยแสงนี้จะมีประสิทธิภาพเหมาะแก่การกำจัดน้ำเสียจากสีย้อม แต่กระบวนการนี้ไม่สามารถกำจัดน้ำเสียในที่ปราศจากแสงได้ ด้วยเหตุนี้เองการเพิ่มประสิทธิภาพของการสลายตัวในที่มีดจึงเป็นการศึกษาที่น่าสนใจ เพื่อบรรลุจุดประสงค์ของงานวิจัยจึงได้นำ สารกึ่งตัวนำชนิด n และ p มาใช้เป็นต้นแบบในการกักเก็บพลังงานออกซิเดชันเพื่อใช้ในกระบวนการสลายตัวในสภาวะไร้แสง การศึกษานี้สังเคราะห์ตัวเร่งปฏิกิริยาจากไทเทเนียมไดออกไซด์ซึ่งเป็นสารกึ่งตัวนำชนิด n และ ซิงค์ออกไซด์ วาเนเดียมไดออกไซด์ซึ่งเป็นสารกึ่งตัวนำชนิด p การขึ้นรูปตัวเร่งปฏิกิริยาชนิด n และ p ทำโดยใช้วิธีโซลเจลและทำเป็นฟิล์มสองชั้นเคลือบบนกระจกสไลด์ นอกจากนี้งานวิจัยยังได้ศึกษาการเปลี่ยนแปลงของอุณหภูมิแคลไซน์และปริมาณของซิงค์ออกไซด์และวาเนเดียมไดออกไซด์อีกด้วย ผลจากการทดลองพบว่า การสลายตัวของสีย้อมทั้งในสภาวะมีแสงและไร้แสงสูงสุดเมื่อใช้ฟิล์มสองชั้นซิงค์ออกไซด์บนไทเทเนียมไดออกไซด์ซึ่งซิงค์ออกไซด์ถูกเผาที่อุณหภูมิ 300 °C นอกจากนี้ยังพบอีกว่า เมื่อปริมาณของซิงค์ออกไซด์มากขึ้น จะส่งผลให้การสลายตัวของสีย้อมมากขึ้นด้วย ในทางตรงกันข้ามฟิล์มสองชั้นวาเนเดียมไดออกไซด์บนไทเทเนียมไดออกไซด์ไม่สามารถทำให้เกิดสลายตัวของสีย้อมได้

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