

การประดิษฐ์อุปกรณ์รับรู้แก๊สจากไทเทเนียมไดออกไซด์นาโนไฟเบอร์ที่ทำงานโดยการกระตุ้นด้วย  
รังสียูวี



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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต  
สาขาวิชาปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์  
คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย  
ปีการศึกษา 2556  
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FABRICATION OF UV-ACTIVATED GAS SENSOR FROM TiO<sub>2</sub> NANOFIBER

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A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science Program in Petrochemistry and Polymer  
Science

Faculty of Science

Chulalongkorn University

Academic Year 2013


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Thesis Title FABRICATION OF UV-ACTIVATED GAS SENSOR  
FROM TiO<sub>2</sub> NANOFIBER  
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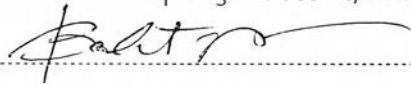
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Fulfillment of the Requirements for the Master's Degree

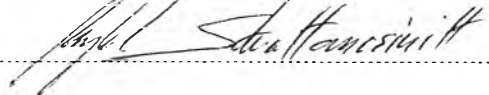
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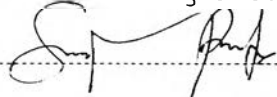
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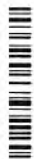
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รณศพงษ์ ไพลินทรสุข : การประดิษฐ์อุปกรณ์รับรู้แก๊สจากไทเทเนียมไดออกไซด์นาโนไฟเบอร์ที่ทำงานโดยการกระตุ้นด้วยรังสียูวี. (FABRICATION OF UV-ACTIVATED GAS SENSOR FROM TiO<sub>2</sub> NANOFIBER) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ดร.บุญโชติ เผ่าสวัสดิ์รณรงค์, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: ผศ. ดร.วรวรรณ พันธุ์นาวิน, 68 หน้า.

ไทเทเนียมไดออกไซด์นาโนไฟเบอร์ถูกเตรียมจากเทคนิคการปั่นเส้นใยด้วยไฟฟ้าสถิต (electrospinning) โดยสารละลายสำหรับการปั่นเส้นใยด้วยไฟฟ้าสถิตประกอบไปด้วยไทเทเนียมไอโซโพรพอกไซด์ (titanium isopropoxide) พอลิไวนิลไพโรลิโดน (polyvinylpyrrolidone) 2-บิวทานอน (2-butanone) ไดเมทิลฟอร์มามายด์ (N,N'-dimethylformamide) และเอทานอล (ethanol) จากนั้นเส้นใยที่เตรียมได้จากเทคนิคการปั่นเส้นใยด้วยไฟฟ้าสถิตไปผ่านกระบวนการ hot-pressing ที่ 180 องศาเซลเซียส เป็นระยะเวลา 10 นาทีและสุดท้ายนำไปอบที่อุณหภูมิ 600 องศาเซลเซียส เป็นระยะเวลา 1 ชั่วโมงก็จะได้ไทเทเนียมไดออกไซด์นาโนไฟเบอร์สำหรับการตรวจวัดแก๊ส สันฐานวิทยาของเส้นใยไทเทเนียมไดออกไซด์นาโนไฟเบอร์ได้ศึกษาจากเทคนิคกล้องจุลทรรศน์อิเล็กตรอนแบบส่องกราด ซึ่งขนาดของเส้นใยไทเทเนียมไดออกไซด์นาโนไฟเบอร์มีขนาดอยู่ที่  $467 \pm 138$  นาโนเมตร สำหรับโครงสร้างผลึกของไทเทเนียมไดออกไซด์นาโนไฟเบอร์ได้ศึกษาจากเทคนิควิเคราะห์จากการเลี้ยวเบนของรังสีเอ็กซ์ พบว่าโครงสร้างผลึกของไทเทเนียมไดออกไซด์นาโนไฟเบอร์นั้นประกอบไปด้วยอะนาทาสเฟส (anatase phase) เป็นส่วนใหญ่และบางส่วนที่เป็นรูไทล์เฟส (rutile phase) พื้นที่ผิวของไทเทเนียมไดออกไซด์นาโนไฟเบอร์มีค่าอยู่ที่ 55.84 ตารางเมตรต่อกรัม นอกจากนี้การวัดมุมสัมผัสน้ำของไทเทเนียมไดออกไซด์นาโนไฟเบอร์แสดงว่าพื้นที่ผิวของไทเทเนียมไดออกไซด์นาโนไฟเบอร์มีความสม่ำเสมออีกด้วย ไทเทเนียมไดออกไซด์นาโนไฟเบอร์ได้ถูกทดสอบการตรวจวัดแก๊สด้วยแอซิโตน (acetone) มีเทน (methane) และเมทานอล (methanol) ที่ปริมาณต่างๆ ปริมาณที่มากที่สุดของแก๊สแอซิโตน มีเทน และเมทานอลที่สามารถตรวจวัดได้นั้น มีค่าอยู่ที่ประมาณ 14 10 และ 12 มิลลิโมล (mmol) ตามลำดับ นอกจากนี้อุปกรณ์รับรู้แก๊สชนิดนี้ยังแสดงให้เห็นถึงศักยภาพในการผลิตชิ้นงานซ้ำที่คงสมบัติเดิมขึ้นมาได้อีกด้วย

สาขาวิชา ปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์ ลายมือชื่อนิสิต

ปีการศึกษา 2556

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# # 5372255223 : MAJOR PETROCHEMISTRY AND POLYMER SCIENCE

KEYWORDS: TITANIUM DIOXIDE / GAS SENSOR / ELECTROSPINNING

THANETPONG PAISUNTHORNSOOK: FABRICATION OF UV-ACTIVATED GAS SENSOR FROM  $\text{TiO}_2$  NANOFIBER. ADVISOR: ASST. PROF. BOONCHOAT PAOSAWATYANYONG, Ph.D., CO-ADVISOR: ASST. PROF. WORAWAN BHANTHUMNAVIN, Ph.D., 68 pp.

Titanium dioxide nanofibers have been fabricated through electrospinning process. Mixtures of titanium isopropoxide, polyvinylpyrrolidone, 2-butanone, N,N'-dimethylformamide, and ethanol were mixed into homogeneous solution for electrospinning. Thereafter, electrospun nanofibers were hot-pressed at 180 °C for 10 minutes. Hot-pressed electrospun titanium dioxide nanofibers were calcined at 600 °C for 1 hour. Finally, titanium dioxide nanofibers as sensing materials were obtained. The morphology of titanium dioxide nanofibers was investigated via SEM technique. The diameter of titanium dioxide nanofibers was  $467 \pm 138$  nm. The crystal structure of titanium dioxide nanofibers was analyzed by XRD analysis. It has been found that titanium dioxide nanofibers majorly consisted of anatase phase along with a small degree of rutile phase. The surface area of titanium dioxide nanofibers was  $55.84 \text{ m}^2/\text{g}$ . Moreover, contact angle measurement of titanium dioxide nanofibers also showed uniform surface of sensing materials. The sensing performance of titanium dioxide nanofibers was tested with acetone, methane, and methanol vapor at various contents. The saturation limit acetone, methane, and methanol vapor was observed about 14, 10, and 12 mmol respectively. Moreover, the gas sensors also show good reproducibility:

Field of Study: Petrochemistry and  
Polymer Science

Academic Year: 2013

Student's Signature Thanetpong Paisunthornsook

Advisor's Signature Boonchoat Paosawatyanong

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## ACKNOWLEDGEMENTS

First of all, I would like to sincerely acknowledge my thesis advisor, Assistant Professor Dr. Boonchoat Paosawatyanong, and my thesis co-advisor, Assistant Professor Dr. Worawan Bhanthumnavin for their great guidance, kindness, and financial support for this research.

I am sincerely grateful to members of thesis committee, Professor Dr. Tharapong Vitidsant, Associate Professor Dr. Mongkol Sukwattanasinitt, and Dr. Sirapat Pratontep for reviewing, suggestion, and valuable comments on this thesis.

This thesis would not have been possible without the supports, help, patience, and motivation of my colleagues. Furthermore, the great financial support provides by ThEP center. I would like to thank the program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University.

I would like to special thank Dr. Dusit Ngamrungraj and Dr. Kanchaya Honglertkongsakul for their enormous helping support, advice, and kindness. Moreover, many thanks go to many friends and all members of Plasma lab for their friendship, discussion, and encouragement during this thesis work.

Finally, I am most thankful to my family for all of their support, greatest love, and encouragement for the period of this education.

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