

**NANOSTRUCTURED METAL OXIDE SYNTHESIS USING
MICROEMULSION FOR PHOTOCATALYTIC DECOMPOSITION AND
GAS SENSOR APPLICATIONS**

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ABSTRACT

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The single (TiO_2 , SnO_2) and/or mixed metal oxides (Nb-TiO_2 , $\text{Nb-TiO}_2\text{-SnO}_2$) were synthesized by two microemulsion, the anionic surfactant system (*n*-heptane/water/NaCl/ sodium bis (2-ethylhexyl) sulfosuccinate (AOT)) and the nonionic surfactant system (cyclohexane/water/Triton X-100). The nanostructural effect, i.e. the crystal size, crystal structure, and surface area and phases of metal oxides were studied in gas and liquid phase applications. For liquid phase, the photolysis of phenol in aqueous solution by using synthesized TiO_2 (single oxide system) as a photocatalyst was examined. For gas phase, both single oxide and mixed metal oxides were used to study CO gas in a sensor application. For liquid phase study, the results indicated that the rate of phenol decomposition can be improved by the exposed titanium sites on the surface controlled by the nanostructure of synthesized TiO_2 . For gas phase study, Nb-doped TiO_2 clearly showed an improved thermal stability by hindering the anatase to rutile phase transformation and inhibiting the grain growth resulting in significant increase in CO sensitivity. For $\text{Nb-TiO}_2\text{-SnO}_2$, the mixed solid solution phase between Ti and Sn and high thermal stability has strong effect on the high sensitivity of CO.

บทคัดย่อ

ธีระ อนุกุลประเสริฐ : การสังเคราะห์โลหะออกไซด์โดยใช้ไมโครอิมัลชันเป็นเครื่องปฏิกรณ์นาโนเพื่อการประยุกต์ในการสลายตัวด้วยแสงและการตรวจจับก๊าซ (Nanostructured Metal Oxide Synthesis Using Microemulsion for Photocatalytic Decomposition and Gas Sensor Applications) อ. ที่ปรึกษา : รศ. ดร. จินตนา สายวรรณ และ ศ. เอ็นริโก ทราเวอร์ซา xx หน้า ISBN 974-9990-15-3

การสังเคราะห์โลหะออกไซด์ (ไททาเนียมไดออกไซด์ และ ทินออกไซด์) และโลหะออกไซด์แบบผสม (ไนโอเบียมโคปไททาเนียมไดออกไซด์ และ ไนโอเบียมโคปไททาเนียมออกไซด์และทินออกไซด์) โดยใช้ไมโครอิมัลชันสองระบบ ได้แก่ ระบบที่ใช้สารลดแรงตึงผิวชนิดมีขั้วลบ (นอมอลเฮปเทน/น้ำ/โซเดียมคลอไรด์/โซเดียมบิสฟุเอททิลเฮกซิลซัลโฟซักซิเนต (เอโอที)) และระบบที่ใช้สารลดแรงตึงผิวที่ไม่มีขั้ว (ไซโคเฮกเซน/น้ำ/ไททรอนเอ็กซ์-100) การศึกษาผลกระทบเนื่องมาจากโครงสร้างในระดับนาโนเมตร เช่น ขนาดของโครงสร้างผลึก รูปร่าง โครงร่างผลึก พื้นที่ผิวและเฟสของโลหะออกไซด์ต่อการประยุกต์ใช้งานในก๊าซเฟส และในเฟสของเหลว สำหรับเฟสของเหลว ไททาเนียมไดออกไซด์ถูกใช้เป็นตัวเร่งปฏิกิริยาการสลายตัวด้วยแสงของพีนอลในน้ำ และสำหรับเฟสก๊าซ ใช้โลหะออกไซด์และโลหะออกไซด์แบบผสมตรวจจับก๊าซพิษคาร์บอนมอนอกไซด์ ผลการศึกษาในเฟสของเหลวพบว่า อัตราเร็วของปฏิกิริยาการสลายตัวด้วยแสงของพีนอลเพิ่มขึ้นเนื่องจากการเพิ่มแอกทิฟไซต์บนพื้นที่ผิวของไททาเนียมไดออกไซด์ซึ่งเป็นผลจากโครงสร้างระดับนาโนเมตรของไททาเนียมไดออกไซด์ ผลการทดลองในส่วนของก๊าซเฟสพบว่า ไนโอเบียมโคปไททาเนียมไดออกไซด์สามารถเพิ่มความคงทนต่ออุณหภูมิของโลหะออกไซด์ทำให้การเปลี่ยนเฟสจากอนาเทสเป็นรูไทต์เกิดได้ช้าลง อีกทั้งยังช่วยป้องกันการเติบโตของโครงสร้างผลึก ยังผลให้สัญญาณในการตรวจจับก๊าซคาร์บอนมอนอกไซด์เพิ่มขึ้นอย่างรวดเร็ว สำหรับผลจากการทดลองที่ใช้ไนโอเบียมโคปไททาเนียมและทินออกไซด์ พบว่าการเพิ่มขึ้นอย่างรวดเร็วของสัญญาณการตรวจจับก๊าซคาร์บอนมอนอกไซด์ของโลหะออกไซด์ผสมดังกล่าวเป็นผลเนื่องมาจากความทนต่ออุณหภูมิสูงและผลจากเฟสผสมระหว่างไททาเนียมและทินออกไซด์

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