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ซิงค์ซัลไฟด์ขนาดนาโนเมตรในไมโครอิมัลชัน

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EFFECTS OF TYPES OF ANIONS AND COSURFACTANTS ON ZnS
NANOPARTICLES SYNTHESIS IN MICROEMULSION

Mr. Amornsak Chanagul

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for the Degree of Master of Engineering Program in Chemical Engineering

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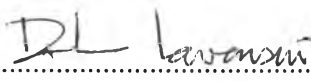
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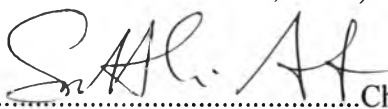
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Thesis Advisor Associate Professor Tawatchai Charinpanitkul, D.Eng.
Thesis Co-advisor Professor Wiwut Tanthapanichakoon, Ph.D.


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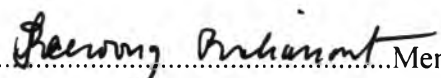

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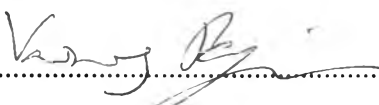
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(Assistant Professor Seeroong Prichanont, Ph.D.)


.....Member
(Varong Pavafajarn, Ph.D.)

อมรศักดิ์ ชนะกุล : ผลของชนิดของไอออนลบและสารลดแรงตึงผิวร่วมต่อการสังเคราะห์อนุภาค ซิงค์ซัลไฟด์ขนาดนาโนเมตรในไมโครอิมัลชัน (EFFECTS OF TYPES OF ANIONS AND COSURFACTANTS ON ZnS NANOPARTICLE SYNTHESIS IN MICROEMULSION), อ. ที่ปรึกษา: รศ.ดร. รัชชัย ชรินพานิชกุล, อ.ที่ปรึกษาร่วม: ศ.ดร. วิวัฒน์ ตัณฑะพานิชกุล, ISBN:974-17-5093-5

ปัจจุบันการสังเคราะห์อนุภาคของสารกึ่งตัวนำในหมู่ II-VI ระดับนาโนเมตรได้รับความนิยมกันอย่างแพร่หลายเนื่องจากคุณสมบัติที่เชื่อมโยงทั้งทางด้านการเป็นตัวเร่งปฏิกิริยา, อุปกรณ์ทางแสง, การใช้งานทางอิเล็กทรอนิกส์ และอื่นๆอีกมากมาย การสังเคราะห์อนุภาคซิงค์ซัลไฟด์ระดับนาโนเมตรนั้นสามารถทำได้หลายวิธี ซึ่งการใช้เทคนิคของไมโครอิมัลชันก็เป็นอีกวิธีหนึ่ง ซึ่งมีความได้เปรียบวิธีอื่นคือ ใช้สารเคมีที่มีอันตรายน้อย ไม่ต้องทำการทดลองที่อุณหภูมิ หรือความดันสูง และเครื่องมือที่มีราคาไม่สูงมากนัก

ในงานวิจัยนี้ได้ทำการศึกษาตัวแปรหลายตัวเพื่อหาสภาวะที่เหมาะสมในการสังเคราะห์อนุภาคซิงค์ซัลไฟด์ระดับนาโนเมตรที่มีขนาดและรูปร่างใกล้เคียงกัน ทั้งอิทธิพลของสารลดแรงตึงผิวร่วม ไอออนลบ ความเข้มข้นของสารตั้งต้น อัตราส่วนโมลของน้ำต่อสารลดแรงตึงผิว และอุณหภูมิ ซึ่งจากผลการทดลองพบว่า อนุภาคระดับซิงค์ซัลไฟด์ระดับนาโนเมตรรูปร่างที่น่าสนใจ เช่น ท่อนาโน หรือ นาโนแบบแท่ง ได้ โดยจำเป็นต้องใช้ความเข้มข้นของสารตั้งต้น และค่าอัตราส่วนโมลของน้ำต่อสารลดแรงตึงผิวที่สูงพอ นอกจากนี้ยังพบว่าสารลดแรงตึงผิวร่วมที่มีโมเลกุลขนาดใหญ่สามารถช่วยให้เกิดอนุภาคระดับนาโนเมตรรูปร่างเหล่านี้ได้มากยิ่งขึ้น

การเติมไอออนลบเช่น คลอไรด์และโบรไมด์ ลงไปในไมโครอิมัลชันจะสามารถช่วยให้เกิดอนุภาคระดับนาโนเมตรที่มีรูปร่างแบบแท่งและเข็มได้มากขึ้น โดยเฉพาะเมื่อใช้บิวทานอลซึ่งมีขนาดโมเลกุลเล็กกว่าเป็นสารลดแรงตึงผิวร่วม นอกจากนี้การเปลี่ยนแปลงอุณหภูมิของการเกิดปฏิกิริยายังมีผลกระทบต่อขนาดและรูปร่างของอนุภาค และเกิดอนุภาคระดับนาโนเมตรที่มีรูปร่างที่น่าสนใจ เช่น ท่อนาโน และ เส้นใยนาโนที่ขนาดเส้นผ่านศูนย์กลางที่เล็กมากๆได้ เป็นต้น

ภาควิชา.....วิศวกรรมเคมี.....ลายมือชื่อนิสิต.....อมรศักดิ์ ชนะกุล.....
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AMORNSAK CHANAGUL: EFFECTS OF TYPES OF ANIONS AND COSURFACTANTS ON ZnS NANOPARTICLE SYNTHESIS IN MICROEMULSION, THESIS ADVISOR: ASSOC. PROF. TAWATCHAI CHARINPANITKUL, D.Eng., THESIS CO-ADVISOR: PROF. WIWUT TANTHAPANICHAKOON, Ph.D., ISBN: 974-17-5093-5

Now, much attention has been paid to synthesis of group II-VI semiconductor materials due to their excellent properties in catalysis, optical and magnetic functionality, and so on. There are many methodologies available for synthesizing ZnS nanocrystals, however, water-in-oil (w/o) microemulsions technique is one of the most recognized one due to its several advantages, for instance, soft chemistry, demanding no extreme pressure or temperature control, easy to handle, and requiring no special or expensive equipment.

In this research, the effects of types of cosurfactants, the molar ratio of water to surfactant, reactant, types of anions and temperature are investigated. From the experimental results, it could be clearly shown that the size and the morphology of the ZnS nanoparticles are dependent upon these parameters. With relatively high reactant concentration and w_o , some certain amount of ZnS nanorod and nanotubes could be successfully synthesized. Moreover, microemulsion with larger molecule of cosurfactant could provide higher possibility to synthesize these morphologies of the nanoparticles.

When adding anions such as Cl^- or Br^- into the microemulsion, the higher population of ZnS nanorods and nanoneedles were obtained, especially when employing n-butanol as a cosurfactant. Moreover, the reaction temperature can greatly effect on the morphology and size of the resulting nanoparticles. The interesting morphologies of ZnS nanoparticles were obtained such as nanotubes and nanowires with very small diameter.

Department.....Chemical Engineering.....Student's signature...*Amornsak Chanagul*
 Field of study.....Chemical Engineering.....Advisor's signature...*T. Charinpanitkul*
 Academic year.....2005.....Co-advisor's signature...*W. Tanthapanichakoon*



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NOMENCLATURES

SEM	Scanning Electron Microscope
TEM	Transmission Electron Microscope
XRD	X-ray diffraction
DLS	Dynamic Light Scattering
EDX	Energy Dispersive X-ray
$C_{\text{cosurfactant}}$	Concentration of cosurfactant
$C_{\text{TX-100}}$	Concentration of Triton X-100
C_{hex}	Concentration of cyclohexane
w_0	The molar ratio of water to surfactant