

การสังเคราะห์และตรวจสอบลักษณะสมบัติของไมโครแคปซูลพอลิยูเรียที่บรรจุตัวย้อมลิวโค



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จุฬาลงกรณ์มหาวิทยาลัย

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ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

**SYNTHESIS AND CHARACTERIZATION OF POLYUREA MICROCAPSULES
CONTAINING LEUCO DYE**



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**ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย**

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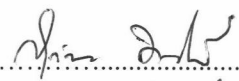
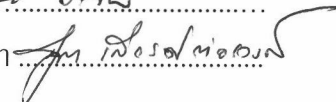
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งานวิจัยนี้ได้สังเคราะห์ไมโครแคปซูลพอลิยูเรียที่บรรจุสีลิ่วโค ด้วยเทคนิค interfacial polymerization โดยศึกษาผลของอัตราส่วนของวัสดุแกนต่อสารก่อผนัง ชนิดของไดไอโซไซยานาต (HDI และ MDI) และเอทิลีนไดเอมีน (EDA) ต่อสัณฐานวิทยาของพื้นผิว การกระจายของขนาดอนุภาค สมบัติเชิงความร้อนและประสิทธิภาพในการบรรจุสารสีลิ่วโคในไมโครแคปซูล รวมทั้งตรวจสอบลักษณะการใช้งานของกระดาษอัดสำเนาไร้คาร์บอน โดยวัดระดับความเข้มข้นของสีลิ่วโคที่เกิดจากทำปฏิกิริยาบนกระดาษที่เคลือบสารรับสี การพิสูจน์ลักษณะสมบัติของไมโครแคปซูลพบว่าปริมาณสารก่อผนังที่ไม่เพียงพอทำให้เกิดผนังแคปซูลที่ไม่สมบูรณ์ และชนิดของไดไอโซไซยานาตเป็นปัจจัยหลักในการกำหนดลักษณะและสมบัติ พบว่าไมโครแคปซูลที่มีส่วนประกอบของ MDI มีพื้นผิวที่หยาบและมีการกระจายของขนาดอนุภาคที่กว้างกว่าไมโครแคปซูลที่ประกอบด้วย HDI ทั้งนี้เนื่องจากความว่องไวในปฏิกิริยาของ MDI มากกว่า HDI การศึกษาสมบัติเชิงความร้อนพบว่าไมโครแคปซูลที่มี MDI เป็นองค์ประกอบให้สมบัติเชิงความร้อนที่ดีกว่า ซึ่งเกี่ยวเนื่องกับการที่ไมโครแคปซูลมีผนังที่หนากว่าและลักษณะของโซ่พอลิยูเรียที่มีความแข็งมากกว่า EDA สามารถเพิ่มความแข็งของผนังแคปซูลและเพิ่มประสิทธิภาพในการบรรจุวัสดุแกน การเติม EDA ในปริมาณที่เหมาะสมนั้นให้ค่าความเข้มของภาพพิมพ์ที่ดีขึ้น งานวิจัยนี้ได้อธิบายเหตุและผลของการเกิดไมโครแคปซูลและความสัมพันธ์ต่อความเข้มของภาพพิมพ์ที่ได้

ศูนย์วิทยทรัพยากร
 จุฬาลงกรณ์มหาวิทยาลัย

หลักสูตรปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์
 สาขาวิชาปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์
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This thesis synthesized polyurea microcapsules containing leuco dye by interfacial polymerization. Wall materials and the ratios of core-to-wall were investigated to improve the characteristics of the microcapsules. The effect of core-to-wall ratio, wall material types (HDI, MDI and EDA) on the morphologies, particle size distribution of the resultant microcapsules, thermal properties and encapsulation efficiency were investigated. Image intensity on the dye acceptor coated paper was determined. Insufficient wall materials were found to yield an incomplete encapsulation. The factors affecting characteristics of the microcapsules depended on the structure of diisocyanate and amount of EDA. The MDI-based polyurea microcapsules had a wider particle size distribution, a much rougher surface than the HDI-based polyurea microcapsules because of the rapid wall forming of MDI. The higher decomposition temperature of MDI-based microcapsules seemed to be related to the wall thickness, strong urea linkage from the rapid reaction and stiff chains of polyurea. EDA was utilized as a hardening agent for the microcapsule wall and which enhanced the microencapsulation efficiency. The sufficient amount of EDA added provided the better image intensity. This research explained the possible causes of microencapsulation and their relationship to the intensity of the images.

Program Petrochemistry and Polymer Science.

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Field of study Petrochemistry and Polymer Science.

Advisor's signature *Suda Kiatkamjornwong*

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LIST OF SYMBOLS & ABBREVIATIONS

| | |
|------|---|
| BLMB | Bensoyl leuco methylene blue |
| CB | Coated back |
| CF | Coated front |
| CVL | Crystal violet lactone |
| DAA | Diamino anthraquinone |
| DLS | Dynamic light scattering |
| DMAc | Dimethyl acetamine |
| EDA | Ethylene diamine |
| FTIR | Fourier transform infrared spectroscopy |
| HDA | Hexamethylene diamine |
| HDI | Hexamethylene diisocyanate |
| IPDI | Isocyanato isocyanatomethyl trimethyl cyclohexane |
| MDA | Diamino diphenyl methane |
| MDI | Methylphenyl diisocyanate |
| NCR | National Cash Register Corporation |
| ppm | Parts per million |
| PTMO | Phenyl tri-methoxysilane |
| PTMS | Poly(tetra methylene oxide) |
| PVA | Poly(vinyl alcohol) |
| SAXS | Synchrotron small angle X-ray scattering |
| SEM | Scanning electron microscopy |
| TDI | Toluene diisocyanate |
| TGA | Thermogravimetric analysis |
| UV | Ultraviolet visible |