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ION AND TEMPERATURE SENSOR FROM POLYDIACETYLENE

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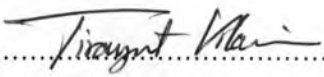

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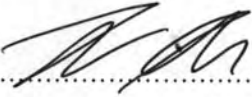

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พอลิไดอะเซทิลีนเป็นคอนจูเกตพอลิเมอร์ที่น่าสนใจโดยมีคุณสมบัติทางสีที่สามารถประยุกต์ใช้ในงานด้านเซ็นเซอร์ แต่ทว่าในงานวิจัยเกี่ยวกับพอลิไดอะเซทิลีนยังต้องการความเข้าใจเกี่ยวกับกลไกการเปลี่ยนแปลงสี และการพัฒนาการใช้งานให้สะดวก ในงานวิจัยนี้ประสบความสำเร็จในการเตรียมฟิล์มบางแบบหลายชั้นที่เตรียมจากพอลิเมอร์ประจุบวก ไคโตซานหรือพอลิเอทิลีนอิมิน และพอลิเมอร์ประจุลบของ พอลิ 10,12-เพนตะโคไซด์ไอออนิก แอซิด เวลีเคิล โครงสร้างทรงกลมรวมถึงคุณสมบัติทางสีที่สำคัญของเวลิเคิลยังคงสภาพในฟิล์ม กลไกการเปลี่ยนสีของพอลิไดอะเซทิลีนเวลิเคิลศึกษาโดยการดูคลื่นแสงระบุนการเปลี่ยนแปลงของหมู่ข้างเคียงของพอลิเมอร์สองชนิด ได้แก่ การเปลี่ยนแปลงที่ผันกลับได้ของสายไซแอลิฟาติกและการเปลี่ยนแปลงที่ผันกลับไม่ได้ของการสลายพันธะไฮโดรเจน ในการเปลี่ยนแปลงสีโดยอุณหภูมิ กลไกการเปลี่ยนสีเริ่มจากการเปลี่ยนคอนฟอร์เมชันของหมู่ข้างเคียงแบบผันกลับได้ซึ่งทำให้เกิดเวลิเคิลสีม่วงตามด้วยการสลายตัวของพันธะไฮโดรเจน ในการเปลี่ยนแปลงสีตามตัวทำละลายเอทานอลและค่าความเป็นกรด กลไกการเปลี่ยนสีเริ่มจากการรบกวนที่พื้นผิวของเวลิเคิลโดยตรงทำให้พันธะไฮโดรเจนแตกออก เซ็นเซอร์ตรวจจับไอออนของตะกั่วชนิดที่มีความจำเพาะเจาะจงสูงซึ่งพัฒนาขึ้นโดยอาศัยการเพิ่มความไวต่อแรงกระทำที่พื้นผิวของพอลิไดอะเซทิลีนด้วยสารประกอบเอสเทอร์ระหว่าง ไตรเอทิลีนไกลคอลกับ10,12-เพนตะโคไซด์ไอออนิก แอซิด นอกจากนี้ สีสกรีนที่เปลี่ยนแปลงตามอุณหภูมิยังได้รับการพัฒนาจาก พอลิไดอะเซทิลีนเพื่อใช้เป็นฉลากที่ไวต่ออุณหภูมิ

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ANUPAT POTISATITYUENYONG : ION AND TEMPERATURE
SENSOR FROM POLYDIACETYLENE. THESIS ADVISOR:
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Polydiacetylene (PDA) is an interesting class of conjugated polymer having unique chromic properties suitable for many sensing applications. Although extensive research in PDA for sensing applications have been reported, there is still research gaps in understanding of its color transition mechanism and developing it into a convenient to use platform with high sensitivity and selectivity. In this dissertation, polyelectrolyte multilayer (PEM) thin films using either chitosan or poly(ethylenimine) as a polycation and polymerized 10,12-pentacosadiynoic acid vesicles (poly(PCDA)) as a polyanion are successfully prepared. The spherical structures of vesicles, as well as their important chromic properties are retained in the PEM films. Color transition mechanism of poly(PCDA) vesicles probed by electronic absorption spectroscopy indicates two types of sidechain movement: the reversible conformational change of the aliphatic chains and the irreversible hydrogen bond breaking. In the thermochromism, the transition starts with reversible conformational alteration of methylene side chains leading to metastable purple vesicles followed by the hydrogen bonds breaking. In the ethanolochromism and alkalinochromism, the processes are however induced at the vesicle-media interface, directly bringing about the hydrogen bond breaking. The highly selective colorimetric lead ion sensor is developed based on the interaction at the poly(PCDA) vesicle surface using triethylene glycol ester of PCDA (TEGPCDA) as the sensitivity enhancer. Furthermore, thermochromic screen ink is also developed from poly(PCDA) for temperature sensitive labeling.

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List of Abbreviations and Signs

Å	Angstrom
AFM	Atomic force microscopy
¹³ C-NMR	Carbon nuclear magnetic resonance
cm	Centimeter
δ	Chemical shift
%CR	% Colorimetric response
<i>J</i>	Coupling constant
°C	Degree celsius
DLS	Dynamic light scattering
g	Gram
Hz	Hertz
kcal	Kilocalorie
mL	Millilitre
mmol	Millimole
M	Molar
nm	Nanometer
ppm	Part per million
cm ⁻¹	Per centimetre
M ⁻¹	Per molar
¹ H-NMR	Proton nuclear magnetic resonance
TEM	Transmission electron microscope
UV/vis	Ultra violet-visible
λ	Wavelength

List of Numbered Compounds

α-CD	alpha-cyclodextrin
AEPCDA	aminoethyl-10,12-pentacosadiynamide
PCDANH₂	aminoethyl-10,12-pentacosadiynamide
CHO	cholesterol
EBPCDA	<i>N,N'</i> -ethylene-bis-(10,12-pentacosadiynamide)
MPCDA	methyl-10,12-pentacosadiynoate
PCDA	10,12-pentacosadiynoic acid
PC	phosphatidylcholine
PAH	poly(allylamine hydrochloride)
PDA	polydiacetylene
PEM	polyelectrolyte multilayer
PEI	poly(ethylenimine)
Poly(PCDA)	poly(10,12-pentacosadiynoic acid)
Poly(TCDA)	poly(10,12-tricosadiynoic acid)
PCDA-mBza	10,12-pentacosadiynamide of <i>m</i> -aminobenzoic acid
PSS	poly(styrene sulfonate)
PVA	poly(vinyl alcohol)
PVC	poly(vinyl chloride)
SLO	steptolysin
TEGPCDA	triethylene glycol ester of-10,12-pentacosadiynoic acid