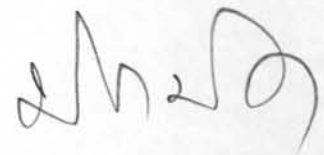


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FORMATION AND BIOCOMPATIBILITY OF MULTILAYER FILMS
ASSEMBLED FROM CHARGED DERIVATIVES OF CHITOSAN

Miss Wilaiporn Graisuwan

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

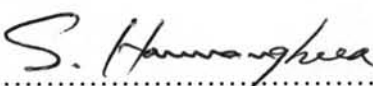
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Thesis Advisor Assistant Professor Voravee P. Hoven, Ph.D.
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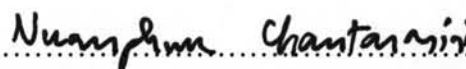
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อนุพันธ์ที่มีประจุของไคโทซาน, เอ็น-[(2-ไฮดรอกซิล-3-ไตรเมทิลแอมโมเนียม)โพรพิล]ไคโทซาน คลอไรด์, เอ็น-ซัคซินิลไคโทซาน และเอ็น-ซัลโฟเฟอริลไคโทซาน ถูกเตรียมขึ้นโดยปฏิกิริยาเปิดวงของ โกลซิดิล ไตรเมทิลแอมโมเนียมคลอไรด์, ปฏิกิริยาการเปิดวงของซัคซินิกแอนไฮไดรด์ด้วยหมู่เอมิโนของ ไคโทซาน และปฏิกิริยารีดักทีฟอัลคิลเลชัน โดยใช้เกลือโซเดียมของ 5-ฟอร์มิล-2-ฟิวแรนซัลโฟนิคแอซิด เป็นรีเอเจนต์ ตามลำดับ วิเคราะห์โครงสร้างทางเคมีของอนุพันธ์ที่สังเคราะห์ได้ด้วยโปรตอนเอ็นเอ็มอาร์ และเอฟทีไออาร์ เตรียมมัลติเลเยอร์ฟิล์มของอนุพันธ์ที่มีประจุของไคโทซานและพอลิเอ็กโทโรไลต์ที่มี ประจุตรงข้ามได้โดยวิธีการดูดซับแบบประกอบชั้นต่อชั้นบนพื้นผิวขั้วลบของพอลิเอทิลีนเทเรฟทาเลต ที่ผ่านการบำบัดพื้นผิวได้ ติดตามกระบวนการประกอบเป็นฟิล์มด้วยควอดซ์คริสตัลไมโครบาลานซ์ ผลจากการวัดมุมสัมผัสของน้ำแสดงให้เห็นว่ามัลติเลเยอร์ฟิล์มมีลักษณะเป็นชั้น ตรวจสอบการปกคลุมของ ฟิล์มที่ประกอบขึ้นด้วยอะตอมมิกฟอสโฟไรไมโครสโกปีและเอทีอาร์เอฟทีไออาร์สเปกโทรสโกปี จากการ ทดสอบการตอบสนองทางชีวภาพของฟิล์มที่ประกอบขึ้นที่มีต่อการยึดเกาะและการเพิ่มจำนวนของเซลล์ ไฟโบรบลาสต์ในหลอดทดลอง แสดงแนวโน้มแบบสลับเล็กน้อยขึ้นกับฟิล์มชั้นนอกสุด ผลจากงานวิจัยนี้ ยังแสดงให้เห็นว่าอนุพันธ์ที่มีประจุทั้งสามชนิดของไคโทซานเป็นตัวเลือกที่มีศักยภาพในการนำไป ประยุกต์ทางด้านชีวการแพทย์

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KEY WORD: CHARGED DERIVATIVE / LAYER-BY-LAYER ADSORPTION /
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WILAIORN GRAISUWAN: FORMATION AND BIOCOMPATIBILITY OF
MULTILAYER FILMS ASSEMBLED FROM CHARGED DERIVATIVES OF
CHITOSAN. THESIS ADVISOR: ASST. PROF. VORAVEE P. HOVEN, Ph.D,
THESIS CO-ADVISOR: PROF. SUDA KIATKAMJORNWONG, Ph.D, 84 pp.

Charged derivatives of chitosan, *N*-[(2-hydroxyl-3-trimethylammonium)propyl] chitosan chloride (HTACC), *N*-succinyl chitosan (SCC), and *N*-sulfofurfuryl chitosan (SFC) were prepared by ring opening of glycidyltrimethylammonium chloride (GTMAC), ring opening of succinic anhydride (SA) by amino groups of chitosan, and reductive alkylation using 5-formyl-2-furansulfonic acid, sodium salt (FFSA) as a reagent, respectively. The chemical structures of the charged derivatives were verified by ¹H NMR and FTIR. Multilayer films of charged derivatives of chitosan and selected oppositely charged polyelectrolytes on the surface-treated poly(ethylene terephthalate) (treated PET) substrates were fabricated by alternate layer-by-layer assembly. The assembly process was monitored by quartz crystal microbalance (QCM). Stratification of the multilayer film was demonstrated by water contact angle data. The coverage of the assembled films was characterized by atomic force microscopy and ATR-FTIR spectroscopy. Biological responses of the assembled films as assessed by *in vitro* cell adhesion and proliferation of fibroblasts showed slight alternating trend depending on the outermost layer. The results also suggest that these three charged derivatives of chitosan are potential candidates for biomedical applications.

Field of study.....Petrochemistry and Polymer Science.....Student' signature.....Wilaiorn Graisuwan

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LIST OF ABBREVIATION

AFM	: Atomic Force Microscopy
ATR-FTIR	: Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy
CHI	: Chitosan
DD	: Degree of deacetylation
DMSO	: Dimethylsulfoxide
FBS	: Fetal bovine serum
FFSA	: 5-Formyl-2-furansulfonic acid, sodium salt
FTIR	: Fourier Transform Infrared Spectroscopy
GTMAC	: Glycidyltrimethylammonium chloride
HATCC	: <i>N</i> -[(2-hydroxyl-3-trimethylammonium)propyl]chitosan chloride
IRE	: Internal reflection element
L929	: Fibroblast cell
LBL	: Layer-by-layer
MTT	: 3-(4,5-Dimethyl-thiazol-2-yl)-2,5-diphenyl tetrazolium bromide
NMR	: Nuclear Magnetic Resonance Spectroscopy
OD	: Optical density
PAA	: Poly(acrylic acid), sodium salt
PAH	: Poly(allylamine hydrochloride)
PSS	: Poly(sodium styrene sulfonate)
QCM	: Quartz Crystal Microbalance
RPMI	: Roswell Park Memorial Institute

SA	: Succinic anhydride
SCC	: <i>N</i> -succinyl chitosan
SFC	: <i>N</i> -sulfofurfuryl chitosan
SPM	: Scanning Probe Microscopy
TBO	: Toluidine blue O
TCPS	: Tissue culture polystyrene
TSM	: Thickness shear mode