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จุฬาลงกรณ์มหาวิทยาลัย

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**SURFACE MODIFICATION OF NATURAL RUBBER BY GRAFT
COPOLYMERIZATION OF HYDROPHILIC MONOMERS TO
IMPROVE BLOOD COMPATIBILITY**

Miss Kamolmart Chombanpaew



**A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Petrochemistry and Polymer Science**


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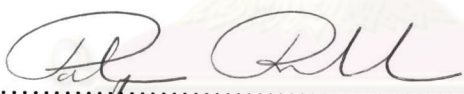
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กมลมาตย์ ชมบ้านแพ้ว: การดัดแปรพื้นผิวของยางธรรมชาติโดยกราฟต์โคพอลิเมอร์ไฮโดรฟิลิกของมอนอเมอร์ที่ชอบน้ำเพื่อปรับปรุงสมบัติความเข้ากันได้กับเลือด (SURFACE MODIFICATION OF NATURAL RUBBER BY GRAFT COPOLYMERIZATION OF HYDROPHILIC MONOMERS TO IMPROVE BLOOD COMPATIBILITY) อาจารย์ที่ปรึกษา: ดร. เพียรพรอค ทศคร; อาจารย์ที่ปรึกษาร่วม: ดร. วิภาวี ไฮเว่น; หน้า ISBN

งานวิจัยนี้ศึกษาการดัดแปรพื้นผิวของยางธรรมชาติทั้งที่ผ่านการวัลคาไนซ์และไม่ผ่านการวัลคาไนซ์ด้วยมอนอเมอร์ที่ชอบน้ำ คือ พอลิเอทิลีนไกลคอลเมทาคริเลต, เอ็นไวนิลไพโรลิโดน และ 2-เมทอะคริโลอิลออกซีเอทิลฟอสโฟริลโคลีน โดยกราฟต์โคพอลิเมอร์ไฮโดรฟิลิกขึ้นเหนี่ยวนำด้วยแสงยูวีโดยใช้เบนโซทริโพนเป็นสารประกอบไวแสง ปริมาณการกราฟต์มีค่าเพิ่มขึ้นเมื่อเวลาในการกราฟต์และความเข้มข้นของมอนอเมอร์เพิ่มขึ้น โดยยางวัลคาไนซ์จะมีปริมาณการกราฟต์ที่เพิ่มขึ้นในสัดส่วนที่น้อยกว่ายางธรรมชาติที่ไม่วัลคาไนซ์ ซึ่งสามารถอธิบายได้จากการที่โครงข่ายที่เกิดขึ้นระหว่างการวัลคาไนซ์เป็นอุปสรรคกีดขวางการแทรกซึมผ่านของทั้งสารประกอบไวแสงและมอนอเมอร์ การปรากฏฟิสิกส์ของยางธรรมชาติหลังจากปฏิกิริยากราฟต์โคพอลิเมอร์ไฮโดรฟิลิกด้วยพอลิเอทิลีนไกลคอลเมทาคริเลต และ 2-เมทอะคริโลอิลออกซีเอทิลฟอสโฟริลโคลีน แสดงให้เห็นว่าการดัดแปรพื้นผิวเกิดขึ้นได้อย่างน้อยถึงระดับความลึกประมาณ 1-2 ไมโครเมตร จากการศึกษาคุณสมบัติของน้ำยางธรรมชาติที่ผ่านการดัดแปรพบว่าความหนาแน่นของการกราฟต์มีค่าเพิ่มขึ้นตามระยะเวลาการกราฟต์และความเข้มข้นของมอนอเมอร์ที่เพิ่มขึ้น การปราศจากการดูดซับของพลาสมาโปรตีนและการยึดเกาะของเกร็ดเลือดบนพื้นผิวของยางธรรมชาติที่มีความหนาแน่นการกราฟต์สูงเป็นข้อยืนยันอย่างชัดเจนว่ายางธรรมชาติที่ผ่านการดัดแปรแล้วมีความเข้ากันได้กับเลือดดีขึ้นอย่างมีนัยสำคัญ นอกจากนี้ยังพบว่าการกราฟต์โคพอลิเมอร์ไฮโดรฟิลิกไม่ส่งผลกระทบต่อสมบัติเชิงกลของยางธรรมชาติ

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สาขาวิชา ปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์ ลายมือชื่ออาจารย์ที่ปรึกษา Dr. P. P.

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KAMOLMART CHOMBANPAEW: SURFACE MODIFICATION OF NATURAL RUBBER BY GRAFT COPOLYMERIZATION OF HYDROPHILIC MONOMERS TO IMPROVE BLOOD COMPATIBILITY. THESIS ADVISOR: PIENPAK TASAKORN, Ph.D., THESIS CO-ADVISOR: VIPAVEE P.HOVEN, Ph.D. pp ISBN

Unvulcanized and vulcanized natural rubber latex films having surfaces grafted with hydrophilic monomers: poly(ethylene glycol) methacrylate (PEGMA), *N*-vinyl pyrrolidone (Vpy), 2-methacryloyloxyethyl phosphorylcholine (MPC) were prepared by UV-induced graft copolymerization using benzophenone as a photosensitizer. The grafting yield increase of vulcanized NR latex films as a function of time and monomer concentration were of lesser magnitude than ones of the unvulcanized NR latex films. This can be explained as a result of the crosslinked network generated during vulcanization acting as an obstacle to the permeation of the photosensitizer as well as the monomer. An appearance of a characteristic carbonyl stretching in NR latex films after the surface grafting of PEGMA and MPC indicated that the modification has proceeded at least to the sampling depth of ATR-IR (~1-2 μm). According to the water contact angle of the modified NR latex films, the surface grafting density became higher as the grafting time and monomer concentration increased. The completely absence of plasma protein adsorption and platelet adhesion on the densely grafted NR latex films is a strong indication of significantly improved blood compatibility. Results from tensile tests suggest that graft copolymerization does not cause adverse effects on mechanical properties of NR latex films.

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LIST OF ABBREVIATIONS

AAc	: Acrylic acid
AAM	: Acrylamide
ADP	: Adenosine diphosphate
Alb	: Albumin
AFM	: Atomic force microscopy
ATR-FTIR	: Attenuated Total Reflectance-Fourier Transform Infrared spectroscopy
BCA	: Bicinchoninic acid
BSA	: Bovin serum albumin
E	: Young's modulus
ESCA	: Electron Spectroscopy for Chemical Analysis
HANR	: High-ammonia natural rubber latex
MPC	: 2-Methacryloyloxyethyl phosphorylcholine
NR	: Natural rubber
PBS	: Phosphate buffer saline
PDI	: Polydispersity Index
PEGMA	: Poly(ethylene glycol) methacrylate
PMPC	: Poly(2-methacryloyloxyethyl phosphorylcholine)
PPP	: Platelet-poor plasma

PRP	: Platelet-rich plasma
SDS	: Sodium dedecyl sulfate
SEM	: Scanning electron microscopy
VPy	: <i>N</i> -vinylpyrrolidone
XPS	: X-ray photoelectron spectroscopy



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