

**CHITOSAN-COATED FOOD PRESERVING FILM SURFACE MODIFIED  
BY USING DBD PLASMA TECHNIQUE FOR ANTIMICROBIAL  
PROPERTY IMPROVEMENT**



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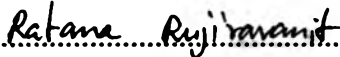
**Thesis Title:** Chitosan-Coated Food Preserving Film Surface Modified by Using DBD Plasma Technique for Antimicrobial Property Improvement  
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**Program:** Polymer Science  
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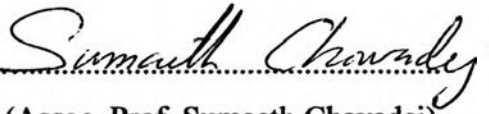
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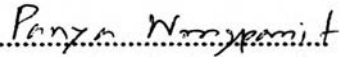
  
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## ABSTRACT

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In order to improve the antimicrobial activity of food preserving films, the surfaces of four polymeric films (PVC, PE, PP, and PLA) were modified by dielectric barrier discharge (DBD) plasma before the chitosan coating to augment the interaction between the polymeric films and chitosan. The plasma-treated polymeric film samples were further immersed in a chitosan acetate solution with different concentrations of chitosan. The degree of deacetylation and the viscosity-average molecular weight of chitosan were 97 % and 807 kDa, respectively. The optimum plasma treatment time was 10 s as determined from contact angle measurements. The effect of the plasma treatment on the surface roughness was determined by atomic force microscopy (AFM). It was found that the surface roughness of all the plasma-treated films increased as compared to the plasma-untreated films. From the spectra of the X-ray photoelectron spectroscopy (XPS), the increments of polar functional groups, such as  $\text{O}=\text{C}-\text{O}^-$  and  $\text{C}-\text{O}^-$ , on the plasma-treated polymeric films were observed. It might be postulated that the DBD plasma enhanced the hydrophilicity of the polymeric films. The effects of chitosan concentration and washing cycles on the amount of coated chitosan on the polymeric films were investigated by the Kjeldahl method. The chitosan-coated polymeric films exhibited excellent antimicrobial activity against *Escherichia coli* and *Staphylococcus aureus*.

## บทคัดย่อ

ศิริภรณ์ เทพศักดิ์ : การเคลือบไคโตซานบนพื้นผิวแผ่นฟิล์มถนอมอาหารที่ถูกดัดแปลงด้วยเทคนิคพลาสมาแบบไดอิเล็กทริกแบริเออร์คิซซาร์จเพื่อเพิ่มคุณสมบัติการต้านเชื้อแบคทีเรีย (Chitosan-Coated Food Preserving Film Surface Modified by Using DBD Plasma Technique for Antimicrobial Property Improvement) อ.ที่ปรึกษา : รศ. ดร.รัตนา รุจิรวนิจ, และ ศ.ดร.เชอิจิ โทคุระ 80 หน้า

ในการเพิ่มคุณสมบัติการต้านเชื้อแบคทีเรียบนพื้นผิวแผ่นฟิล์มถนอมอาหาร พื้นผิวของแผ่นฟิล์มสังเคราะห์ ได้แก่ พอลิไวนิลคลอไรด์ พอลิเอทิลีน พอลิพรอพิลีน และพอลิแลกติกแอซิด จะผ่านการดัดแปลงพื้นผิวด้วยพลาสมาแบบไดอิเล็กทริกแบริเออร์คิซซาร์จเพื่อเพิ่มการมีปฏิสัมพันธ์ระหว่างแผ่นฟิล์มกับไคโตซาน โดยแผ่นฟิล์มที่ผ่านการดัดแปลงพื้นผิวแล้วได้ทำการจุ่มลงในสารละลายไคโตซานอะซิเตทที่มีความเข้มข้นต่างกัน ทั้งนี้ค่าระดับการกำจัดหมู่อะซิทิลและมวลโมเลกุลของไคโตซานที่สกัดได้คือ 97 เปอร์เซ็นต์และ 807 กิโลดาลตลดตามลำดับ เวลาที่เหมาะสมในการดัดแปลงพื้นผิวแผ่นฟิล์มคือ 10 วินาทีซึ่งทดสอบโดยค่ามุมสัมผัสหยดน้ำ จากผลของเวลาในการดัดแปลงพื้นผิวด้วยความขรุขระได้ทำการตรวจสอบโดยกล้องจุลทรรศน์แรงอะตอม (AFM) พบว่าหลังจากการดัดแปลงพื้นผิวแผ่นฟิล์มทั้งสี่จะมีความขรุขระเพิ่มขึ้น จากการวิเคราะห์ทางเคมีด้วยเทคนิค X-ray photoelectron spectroscopy (XPS) พบว่ามีหมู่ฟังก์ชัน  $O=C-O^-$  และ  $C-O^-$  บนพื้นผิวแผ่นฟิล์มเกิดขึ้น ด้วยเหตุนี้สามารถกล่าวได้ว่าพลาสมาแบบไดอิเล็กทริกแบริเออร์คิซซาร์จสามารถเพิ่มคุณสมบัติการดูดซับน้ำ (Hydrophilicity) บนพื้นผิวแผ่นฟิล์ม และในการทดสอบคุณสมบัติการยับยั้งแบคทีเรียพบว่าแผ่นฟิล์มที่ผ่านการดัดแปลงพื้นผิวด้วยพลาสมาและเคลือบด้วยไคโตซานแล้ว จะมีประสิทธิภาพในการต้านเชื้อแบคทีเรียชนิด *Escherichia coli* และ *Staphylococcus aureus* ได้อย่างยอดเยี่ยม

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