

**DEVELOPMENT OF CURCUMIN-BASED SENSORS FOR SMART
PACKAGING APPLICATIONS VIA LAYER-BY-LAYER DEPOSITION AND
ELECTROSPINNING**

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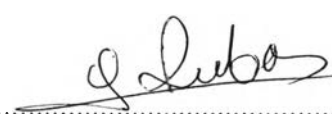
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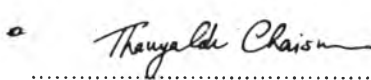
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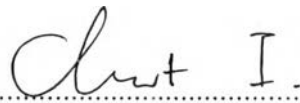
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ABSTRACT

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Curcumin is a yellow pigment extracted from a spice called turmeric which is commonly used in food. It is also a pH-sensitive compound that has the ability to change color from yellow to orange when exposed with acidic and basic conditions, respectively. As a result, it can be used as an optical sensor to detect volatile amine compounds from meat spoilage. In order to assemble curcumin into a sensor, two methods were introduced: the layer-by-layer assembly and electrospinning. The first technique involves loading curcumin onto two types of polyelectrolyte multilayers i.e. PDADMAC/PSS and CHI/ALG. The latter technique combines PVA with curcumin to produce fibers. Next, potassium hydrogen phosphate buffer and ammonia vapor were used to observe the sensing properties of the curcumin thin films and fibers. UV-vis spectroscopy was used to observe the color of the material and SEM was used to observe the fiber morphology. It was found that the sensing properties of curcumin thin film reacts differently with different polyelectrolyte on the top layer. Curcumin on PDADMAC showed earlier change of color at pH 8 unlike PSS that had later change at pH 10. CHI/ALG thin films did not produce orange color at high pH, instead it turns from yellow to colorless at pH 7. Thus, we can tune the pH sensitivity of curcumin thin films. However, the curcumin loaded thin films did not react with ammonia vapor but the fibers changed color at 100 ppm. Conclusively, curcumin fibers are more suitable in ammonia detection; however, both can be used in optical sensor applications.

บทคัดย่อ

- อรจิตร พิชัยสรทัต : การพัฒนาเซ็นเซอร์จากสารสกัดขมิ้นชั้นสำหรับบรรจุภัณฑ์อาหาร โดยใช้ layer-by-layer และ electrospinning (Development of Curcumin-based Sensors for Smart Packaging Applications via Layer-by-Layer Deposition and Electrospinning) อ. ที่ปรึกษา : ผศ. ดร. สเดฟาน เทียรรี คูบาส์ 64 หน้า

ขมิ้นชั้นเป็นสารที่มีสีเหลืองสกัดได้จากขมิ้น ซึ่งสามารถใช้เป็นส่วนประกอบในอาหาร นอกจากนี้ขมิ้นชั้นยังเป็นสารที่ใช้ในการตรวจจับค่าความเป็นกรด-เบสได้ โดยเมื่อเปลี่ยนสถานะจากกรดไปเป็นเบสขมิ้นชั้นจะสามารถเปลี่ยนสีจากสีเหลือง ไปเป็นสีส้ม ดังนั้นจากคุณสมบัติดังกล่าวขมิ้นชั้นจึงสามารถนำมาใช้เป็นตัวตรวจจับไอระเหยของก๊าซแอมโมเนีย ในการนำขมิ้นชั้นมาทำเป็นตัวตรวจจับนั้นจะใช้เทคนิค 2 แบบ คือ การทำเลเยอร์บายเลเยอร์ และอิเล็กโตรสปินนิง โดยการทำให้เลเยอร์บายเลเยอร์จะเป็นการปรับแต่งพื้นผิวของแผ่นกระจกโดยใช้พอลิเมอร์สองชนิด ได้แก่ พอลิไดเอริลไดเมทิลแอมโมเนียมคลอไรด์ กับพอลิสไตรีนซัลโฟเนต และ ไคโตซาน กับอัลจินต ส่วนเทคนิคอิเล็กโตรสปินนิงนั้นจะนำพอลิไวนิลแอลกอฮอล์มาผสมกับขมิ้นชั้น จากนั้นนำมาขึ้นรูปเป็นเส้นใยที่มีขนาดเล็ก ในการทดสอบความไวในการเปลี่ยนสีของขมิ้นชั้นต่อกรดและเบสจะใช้ โพแทสเซียมไฮโดรเจนฟอสเฟต และไอของแอมโมเนียในการทดสอบ โดยจะดูจากสีที่เปลี่ยนไปของฟิล์มและเส้นใย จากผลการทดลองพบว่าในส่วนของเทคนิคเลเยอร์บายเลเยอร์นั้นพอลิเมอร์ชั้นบนสุดจะส่งผลต่อการเปลี่ยนสีของขมิ้นชั้น โดยหากชั้นบนสุดเป็นพอลิไดเอริลไดเมทิลแอมโมเนียมคลอไรด์ ขมิ้นชั้นจะเปลี่ยนสีที่ค่าพีเอชแปด และพอลิสไตรีนซัลโฟเนต จะเปลี่ยนสีที่ค่าพีเอชสิบ ในส่วนของไคโตซาน และอัลจินตนั้น ขมิ้นชั้นจะเปลี่ยนจากสีเหลืองเป็นสีใสที่ค่าพีเอชเจ็ด นอกจากนี้ยังพบอีกว่าขมิ้นชั้นที่เป็นฟิล์มไม่สามารถเปลี่ยนสีกับไอของก๊าซแอมโมเนียได้ แต่ในส่วนขมิ้นชั้นที่เป็นเส้นใยนั้นจะสามารถเปลี่ยนสีเมื่อสัมผัสกับไอของก๊าซแอมโมเนียที่มีค่าความเข้มข้นมากกว่าหนึ่งร้อยมิลลิกรัมต่อลิตรขึ้นไป

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