

PHYSICAL AND ELECTROCHROMIC PROPERTIES OF POLY (2,5-DIMETHOXY ANILINE) SYNTHESIZED IN OXALIC, NITRIC, AND HYDROCHLORIC ACIDS



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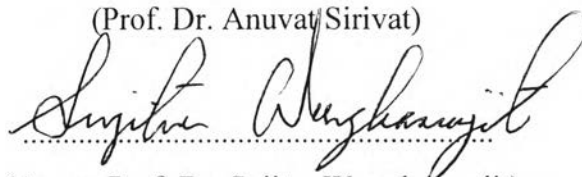


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ABSTRACT

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One of the promising electrochromic polymers is polyaniline, which possess a high environmental stability and fast response time. Nonetheless, the low solubility in common organic solvents restricts processibility. A derivative of polyaniline, poly (2,5-dimethoxy aniline) or PDMA, shows higher solubility and a faster response time than polyaniline. In this work, poly (2,5-dimethoxy aniline) was electrochemically deposited on flexible indium tin oxide in oxalic, nitric and hydrochloric acids at various dipping times. Under different applied potentials, the optical contrast and response time of the PDMA coated plastic indium tin oxide were determined by a UV-visible spectrophotometer. The fastest response times in all acids occurred at 3.5 volts, where the response time was only 3.7 seconds in case of 6 minutes synthesis of PDMA in hydrochloric acid. The Fourier transform infrared (FTIR) spectroscopy indicated that the structure of PDMA coating via three acids were nearly the same except that the FTIR spectrum of PDMA from nitric acid showed an absorption peak at 1384 cm^{-1} representing N-O vibration. The thermal stability of the electropolymerized PDMA films was investigated via thermogravimetric analysis and showed similar three steps of weight loss at $\sim 160\text{ }^{\circ}\text{C}$, $310\text{ }^{\circ}\text{C}$, and $450\text{ }^{\circ}\text{C}$. The surface morphology of PDMA coating depended on the type of acids used for the electropolymerization process.

บทคัดย่อ

บุรีรัตน์ สือพัฒนวิมา : สมบัติทางกายภาพและสมบัติการเปลี่ยนสีด้วยไฟฟ้าของพอลิ 2,5 ไดเมทอกซีอะนิลีนที่สังเคราะห์ใน กรดออกซาลิก กรดไนตริกและกรดไฮโดรคลอริก (Physical and Electrochromic Properties of Poly (2,5-dimethoxy aniline) Synthesized in Oxalic, Nitric, and Hydrochloric Acids) อ. ที่ปรึกษา : ศ. ดร. อนุวัฒน์ ศิริวัฒน์ 159 หน้า

พอลิอะนิลีนเป็นพอลิเมอร์ที่น่าสนใจสำหรับการนำไปใช้เป็นวัสดุที่เปลี่ยนสีด้วยไฟฟ้า เนื่องจากพอลิอะนิลีนมีความเสถียรในสภาวะแวดล้อมทั่วไป อีกทั้ง ยังมีอัตราการเปลี่ยนแปลงสีที่รวดเร็ว แต่เนื่องจากการละลายที่ต่ำในตัวทำละลายอินทรีย์ส่งผลให้เกิดความจำกัดในกระบวนการสังเคราะห์ ในขณะที่อนุพันธ์ชนิดหนึ่งของพอลิอะนิลีน คือพอลิ 2,5 ไดเมทอกซีอะนิลีน ซึ่งมีคุณสมบัติที่สามารถละลายได้ดี และสามารถตอบสนองได้รวดเร็วกว่าพอลิอะนิลีน ดังนั้นสำหรับงานวิจัยนี้ พอลิ 2,5 ไดเมทอกซีอะนิลีน จึงถูกนำมาศึกษาผลของศักย์ไฟฟ้า และความเข้มข้นของอิเล็กโทรไลต์ที่มีต่อเวลา ที่วัสดุใช้ในการเปลี่ยนแปลงสี โดย พอลิ 2,5 ไดเมทอกซีอะนิลีนนั้นถูกสังเคราะห์ด้วยไฟฟ้า ลงบนพลาสติกที่เคลือบด้วย อินเดียม ทินออกไซด์ โดยใช้เวลาในการสังเคราะห์ที่แตกต่างกัน ในกรดออกซาลิก กรดไนตริกและกรดไฮโดรคลอริก จากนั้นพอลิ 2,5 ไดเมทอกซีอะนิลีนที่สังเคราะห์ได้ถูกนำมาศึกษาการเปลี่ยนแปลงสีที่ศักย์ไฟฟ้าต่างๆกัน พบว่าเมื่อศักย์ไฟฟ้าเพิ่มขึ้นการเปลี่ยนสีของพอลิ 2,5 ไดเมทอกซีอะนิลีนรวดเร็วขึ้นอย่างชัดเจน โดยที่พอลิ 2,5 ไดเมทอกซีอะนิลีนที่สังเคราะห์จากกรดทั้งสามชนิดสามารถเปลี่ยนสีได้รวดเร็วที่สุดที่ 3.5 โวลต์ โดยพอลิ 2,5 ไดเมทอกซีอะนิลีนที่ถูกสังเคราะห์ขึ้นในกรดไฮโดรคลอริกด้วยเวลา 6 นาที ใช้เวลาเพียง 3.7 วินาทีในการตอบสนองการเปลี่ยนสีด้วยการรีดักชัน (เหลือง) รวมทั้งออกซิเดชัน (เขียวแกมน้ำเงิน) นอกจากนี้จากผลการทดลองพบว่าความเข้มข้นของสารละลายกรดซัลฟูริกที่ถูกใช้เป็นอิเล็กโทรไลต์นั้น มีผลต่อความว่องไวในการเปลี่ยนแปลงสีด้วย โดยเมื่อความเข้มข้นของอิเล็กโทรไลต์เพิ่มขึ้นจาก 10^{-6} เป็น 10^{-2} M ส่งผลให้พอลิ 2,5 ไดเมทอกซีอะนิลีนตอบสนองในการเปลี่ยนสีได้รวดเร็วขึ้นมากกว่า 20 เท่า

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