

**DEVELOPMENT OF POLYANILINE SENSOR  
FOR ETHANOL DETECTION**

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for the Degree of Master of Science  
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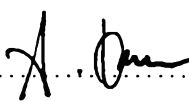
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**By** : Ms. Lucksanaporn Tarachiwin  
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**Thesis Advisors** : Prof. Johannes Schwank  
Assoc. Prof. Anuvat Sirivat


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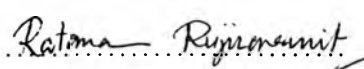
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## ABSTRACT

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The nonconductive form of polyaniline, emeraldine base, was synthesized by the chemical oxidative polymerization of aniline using ammonium peroxydisulfate as an oxidant. Emeraldine base was converted to emeraldine salt (conductive form) by an acid doping process. Three different types of acid dopant; hydrochloric acid (HCl), acetic acid (CH<sub>3</sub>COOH), and hexanoic acid (C<sub>5</sub>H<sub>11</sub>COOH) were used to study the effect of acid dopants and acid/polymer concentration ratio ( $N_a/N_p$ ) on the specific conductivity of polyaniline films. The specific conductivity gradually increased with acid concentration. For HCl-doped polyaniline film, after  $N_a/N_p=9.8E+01$  ( $C_a/C_p=10:1$ ) the specific conductivity decreased due to over-doping. Whereas the specific conductivities of the CH<sub>3</sub>COOH and C<sub>5</sub>H<sub>11</sub>COOH-doped polyaniline films did not depend on acid concentration beyond the mole ratios of  $N_{AcOH}/N_p=5.9E+03$  and  $N_{Hexanoic}/N_p=3.1E+03$  ( $C_a/C_p=1000:1$ ). Polyaniline films were exposed to water and ethanol to study the effect of water and ethanol on the specific conductivity. The change in specific conductivity when the polyaniline films were exposed to water was greater than that when exposed to 100% ethanol. Mechanisms for the change in specific conductivity to water and ethanol are proposed.

## บทคัดย่อ

ลักษณะการ ธาราชีวิติน : การพัฒนาสารพอลิอะนิลีนเพื่อใช้ในการตรวจวัดเอทานอล (Development of Polyaniline Sensor for Ethanol Detection) อ. ที่ปรึกษา : Prof. Johannes Schwank และ รศ. ดร. อนุวัฒน์ ศิริวัฒน์ 102 หน้า ISBN 974-334-176-5

เอมอรالدีนเบส (Emeraldine base) ซึ่งเป็นสารที่ไม่นำไฟฟ้าสถานะหนึ่งของพอลิอะนิลีน (Polyaniline) ถูกสังเคราะห์ทางเคมีโดยใช้แอมโมเนียมเปอร์ออกซิไดซัลเฟต (Ammonium peroxydisulfate) เป็นสารออกซิแดนต์ เอมอรالدีนซอลท์ (Emeraldine salt) ซึ่งเป็นสถานะที่นำไฟฟ้าของพอลิอะนิลีนถูกเตรียมโดยกระบวนการได้ปด้วยกรดไฮโดรคลอริก (Hydrochloric acid), กรดอะซิติก (Acetic acid) และกรดเฮกซาโนอิก (Hexanoic acid) เพื่อศึกษาผลของชนิดของสารได้ปและอัตราส่วนปริมาณของกรดต่อปริมาณพอลิอะนิลีนที่มีต่อค่าการนำไฟฟ้า จากการทดลองพบว่าค่าการนำไฟฟ้าเพิ่มขึ้นเมื่อปริมาณกรดเพิ่มขึ้น ค่าการนำไฟฟ้าของฟิล์มพอลิอะนิลีนที่ได้ปด้วยกรดไฮโดรคลอริกจะมีค่าลดลงเมื่ออัตราส่วนของกรดไฮโดรคลอริกต่อพอลิอะนิลีนมากกว่า 98 เนื่องจากสารได้ปมีปริมาณมากเกินไป ในขณะที่ค่าการนำไฟฟ้าของฟิล์มพอลิอะนิลีนที่ได้ปด้วยกรดอะซิติกและกรดเฮกซาโนอิกเพิ่มขึ้นเมื่อความเข้มข้นของกรดเพิ่มขึ้น และค่าการนำไฟฟ้าไม่ขึ้นกับความเข้มข้นของกรดเมื่ออัตราส่วนของกรดอะซิติกต่อพอลิอะนิลีนเท่ากับ 5900 และอัตราส่วนของกรดเฮกซาโนอิกต่อพอลิอะนิลีนเท่ากับ 3100 เมื่อทดสอบฟิล์มพอลิอะนิลีนในน้ำและเอทานอล พบว่าค่าการนำไฟฟ้าที่ทดสอบในน้ำเกิดการเปลี่ยนแปลงมากกว่าเมื่อทดสอบในเอทานอลเนื่องจากโมเลกุลของน้ำมีขนาดเล็กกว่าเอทานอล กลไกการเปลี่ยนแปลงค่าการนำไฟฟ้าของฟิล์มพอลิอะนิลีนที่ทำการทดสอบในน้ำและเอทานอลได้ถูกเสนอแนะในงานวิจัยครั้งนี้

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