

**PROCESSING OF PROTON EXCHANGE MEMBRANE FOR  
VANADIUM REDOX FLOW BATTERY**

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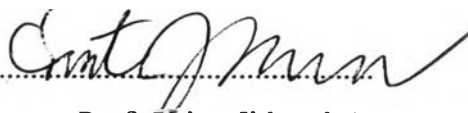
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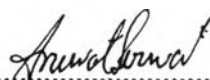


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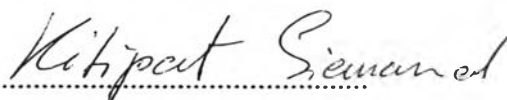
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## ABSTRACT

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Vanadium redox flow battery (VRFB) is a rechargeable energy storage device that converts chemical energy into electrical energy. Commercially, VRFB uses perfluorosulfonic acid, Nafion, as a proton exchange membrane (PEM) due to its high proton conductivity. However, Nafion is an expensive and possesses high vanadium permeability. In order to reduce the limitation of membrane, the modified aromatic membranes, namely poly(ether ether ketone) and poly(phenylene ether ether sulfone), were developed to use as proton exchange membrane through a sulfonation process. The effect of degree of sulfonation on membrane properties as water uptake, proton conductivity, and vanadium permeability were investigated. The increasing degree of sulfonation induced increasing water uptake, proton conductivity, and vanadium permeability. The proton conductivity of sulfonated polymer was higher than Nafion that provided a higher vanadium permeability of sulfonated polymer than Nafion. Thus, the sulfonated polymer membrane fabricated in a VBRF is hopefully achieved to compromise between proton conductivity and vanadium permeability.

## บทคัดย่อ

สมชาย วัฒนปัฐมทรัพย์ : การผลิตเยื่อแลกเปลี่ยนโปรตอนสำหรับใช้งานในแบตเตอรี่ชนิดวานาเดียมรีดอกซ์โพล (Processing of Proton Exchange Membrane for Vanadium Redox Flow Battery) อ. ที่ปรึกษา: รศ.ดร.ศิริรัตน์ จิตรการคำ และ ศ.ดร. อนุวัฒน์ ศิริวัฒน์ 158 หน้า

แบตเตอรี่ชนิดวานาเดียมรีดอกซ์โพลเป็นอุปกรณ์สำหรับเปลี่ยนรูปพลังงานระหว่างพลังงานไฟฟ้าและพลังงานไฟฟ้าเคมี เพื่อทดแทนการผันผวนของความต้องการพลังงานไฟฟ้าในทางการค้านิยมใช้แนฟฟิออนเป็นเยื่อแลกเปลี่ยนโปรตอน เนื่องจากมีค่าการนำโปรตอนสูง อย่างไรก็ตามประสิทธิภาพการแลกเปลี่ยนพลังงานจากแนฟฟิออนต่ำ เนื่องจากแนฟฟิออนมีค่าการแพร่ผ่านของวานาเดียมสูง และมีราคาแพง ปัจจุบันนี้จึงมีแนวโน้มในการใช้เยื่อเลือกผ่านชนิดพอลิเมอร์อะโรแมติก เนื่องจากมีราคาถูกและมีค่าการแพร่ผ่านของวานาเดียมน้อยกว่าแนฟฟิออน ดังนั้นงานวิจัยนี้ได้ศึกษาและพัฒนาเยื่อเลือกเปลี่ยนโปรตอนจากพอลิอีเทอร์อีเทอร์คีโตนและพอลิฟีนิลีน อีเทอร์ อีเทอร์ ซัลโฟน ด้วยกระบวนการซัลโฟเนชัน สำหรับผลกระทบของปริมาณการซัลโฟเนชันที่มีต่อคุณสมบัติของเยื่อแลกเปลี่ยนโปรตอน พบว่าความสามารถในการดูดซับน้ำ ค่าการนำโปรตอน และค่าการแพร่ผ่านของวานาเดียมเพิ่มขึ้น เมื่อปริมาณการซัลโฟเนชันเพิ่ม นอกจากนี้ยังพบว่าเยื่อเลือกเปลี่ยนโปรตอนจากพอลิเมอร์อะโรแมติก มีค่าการนำโปรตอนที่สูงกว่า และค่าการแพร่ผ่านของวานาเดียมต่ำกว่าแนฟฟิออน ด้วยสมบัติดังกล่าวทำให้เยื่อเลือกเปลี่ยนโปรตอนจากพอลิเมอร์อะโรแมติกสามารถนำมาใช้ในทดแทนแนฟฟิออนสำหรับแบตเตอรี่ชนิดวานาเดียมรีดอกซ์โพลได้

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