

Development of Zeolite Membrane for Ethanol Separation



Neeranut Kuanchertchoo

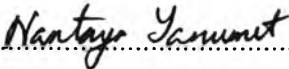
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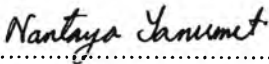
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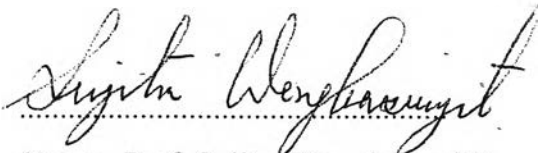
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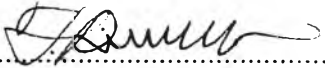

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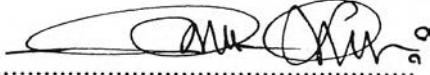

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ABSTRACT

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Zeolites are microporous aluminosilicate materials which may occur naturally or be synthesized in laboratory condition. In this research work, zeolites are synthesized hydro-thermally and the effect of synthesis parameters, such as, hydroxide ion concentration, seed amount as well as heating time and temperature, were studied to obtain uniformed and small size NaA zeolite via sol-gel process and microwave technique. With the composition of $\text{SiO}_2:\text{Al}_2\text{O}_3:x\text{Na}_2\text{O}:410:\text{H}_2\text{O}$; $3 \leq x \leq 6$, the results show that hydroxide ion concentration affects the crystal size and heating time whereas higher amount of seed provides smaller crystal size. NaA zeolite can be synthesized with higher temperature for shorter time or lower temperature for longer time. Recently, the deposition of NaA zeolite on porous supports for membrane application has been extensively studied in the ethanol–water separation process for further use in gasohol production. This work focuses on NaA zeolite membrane synthesized on an Al_2O_3 support via microwave, autoclave and electrophoretic technique and on secondary growth method because it is an effective technique for the promotion of nucleation of crystal on support surface. Synthesis parameter such as synthesis temperature and time, type of substrate, seed amount and the seeding time on the layer growth of membrane are considered. The formation of as-synthesized membranes is discussed according to the observation of SEM and XRD. In addition, a preliminary study of performance of the synthesized NaA zeolite membrane was conducted using pervaporation technique.

transfer and heat distribution, and short reaction time. Based on this concept, the gliding arc microreactor was first designed to investigate the reforming reaction of natural gas instead of using the conventional gliding arc reactor. For this preliminary study, methane, a major constituent of natural gas, was used instead of the simulated natural gas in order to reduce the complexity of feed composition. The reforming of methane was conducted under the gliding arc microreactor, with and without catalyst. In the sole plasma system, all operational parameters affected both methane conversion and product selectivities. In the plasma and catalytic system, the temperature distribution within the plasma microreactor has a significant role in improving the reaction performance.

บทคัดย่อ

น.ส. ธีรนุช ควรรเชิดชู : การพัฒนาซีโอไลต์เมมเบรนสำหรับกระบวนการแยกน้ำจากเอทานอล (Development of Zeolite Membrane for Ethanol Separation) อ.ที่ปรึกษา รศ.ดร. สุจิตรา วงศ์เกษมจิตต์, ดร. สันติ กุลประทีปปัญญา และ รศ. ธีรศักดิ์ ฤกษ์สมบูรณ์ 106 หน้า

ซีโอไลต์ คือ วัสดุอลูมิโนซิลิเกตที่มีรูพรุนขนาดเล็กสามารถเกิดขึ้นเองตามธรรมชาติหรือถูกสังเคราะห์ขึ้นในห้องปฏิบัติการ งานวิจัยนี้ซีโอไลต์ชนิดโซเดียมเอลูกลังเคราะห์ขึ้นโดยวิธีการไฮโดรเทอร์มัล เพื่อศึกษาผลกระทบของตัวแปรต่อการสังเคราะห์ เช่น ความเข้มข้นของไฮดรอกไซด์ไอออน, ปริมาณของผลึกเหนียวนำตลอดจนอุณหภูมิและเวลาที่ใช้ในการให้ความร้อนที่มีต่อการเกิดซีโอไลต์ที่มีขนาดเล็กและสม่ำเสมอโดยกระบวนการโซล-เจลและเทคนิคไมโครเวฟ องค์ประกอบที่ใช้ในการทดลอง คือ $\text{SiO}_2:\text{Al}_2\text{O}_3:\text{xNa}_2\text{O}:410:\text{H}_2\text{O}; 3 \leq \text{x} \leq 6$ จากผลการทดลองแสดงให้เห็นว่า ความเข้มข้นของไฮดรอกไซด์ไอออนส่งผลกระทบต่อขนาดและเวลาที่ใช้ในการให้ความร้อน ในขณะที่ปริมาณของผลึกเหนียวมากขึ้นทำให้ขนาดของผลึกเล็กลง ซีโอไลต์ชนิดโซเดียมเอสามารถสังเคราะห์ขึ้นโดยใช้อุณหภูมิสูงเป็นเวลาสั้นหรืออุณหภูมิต่ำเป็นเวลานาน เมื่อไม่นานมานี้ โซเดียมเอซีโอไลต์บนตัวรองรับที่มีความพรุนตัวถูกนำมาศึกษาเพื่อใช้แยกน้ำออกจากเอทานอล เพื่อนำเอทานอลไปใช้ในกระบวนการผลิตแกสโซฮอล์ งานวิจัยนี้จะเน้นการสังเคราะห์โซเดียมเอซีโอไลต์เมมเบรนบนตัวรองรับอลูมินาโดยใช้เทคนิคไมโครเวฟ, ออโตเครปและอิเล็กโตรโฟเรซิส รวมทั้งใช้กระบวนการเติบโตของผลึกแบบทุติยภูมิซึ่งเป็นเทคนิคที่มีประสิทธิภาพสูงในการทำให้เกิดนิวเคลียสของผลึกโซเดียมเอบนตัวรองรับ ตัวแปรสำหรับการสังเคราะห์ เช่น อุณหภูมิและเวลาที่ใช้ในการสังเคราะห์, ชนิดของตัวรองรับ, ปริมาณของผลึกก่อและเวลาที่ใช้ในการสะสมของผลึกก่อบนตัวรองรับต่อการเติบโตของชั้นซีโอไลต์เมมเบรนถูกนำมาพิจารณา กระบวนการเกิดของเมมเบรนที่สังเคราะห์ถูกนำมาอภิปรายโดยอาศัยผลจาก SEM และ XRD ทำการทดสอบประสิทธิภาพเบื้องต้นโดยใช้กระบวนการเพอร์เวพเพอเรนซ์

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