

**SYNTHESIS AND APPLICATION OF MESOPOROUS  $\text{AlPO}_4\text{-5}$  AND SAPO-5  
BY ATRANE PRECURSORS VIA MICROWAVE HEATING**

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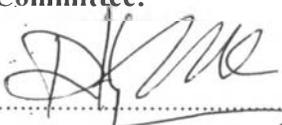
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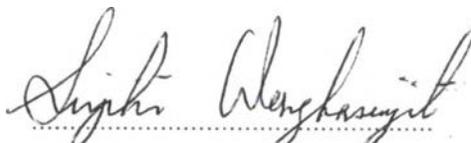
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## ABSTRACT

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Kanchana Utchariyajit: Synthesis and Application of Mesoporous  $\text{AlPO}_4\text{-5}$  and SAPO-5 by Atrane Precursor via Microwave Heating.

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Keywords: Alumatrane/ Silatrane/ Mesoporous AFI/ PROX of CO/ Flower-like SAPO

Alumatrane and silatrane were successfully used as aluminum and silica sources, respectively, for the preparation of mesoporous  $\text{AlPO}_4\text{-5}$  and SAPO-5 zeotype with AFI-type structure under microwave heating using triethylamine (TEA) as structure-directing agent. The influences of chemical composition, aging time, and microwave temperature and time were investigated. The results showed that a long hexagonal rod-like structure was formed in the case of mesoporous  $\text{AlPO}_4\text{-5}$  zeotype. Amounts of the structure-directing agent and water; reaction temperature and time affected on crystal morphology and crystallinity. The lower microwave temperature can be compensated by the longer crystallization time. The presence of Si in the synthesis mixture forming SAPO-5 zeotype with AFI-type structure disturbed the crystals' growth in the *c*-direction, as a result, becoming a short plate-like hexagon. TEM results showed that the samples contained a classical single crystal and 10–100 nm mesoporous matrix nanostructure having the AFI structure. The synthesis of silicoaluminophosphate (SAPO) without adding the TEA structure-directing agent resulted in flower-like SAPO consisting of six petals due to the generation of trialkanoamines molecules during hydrolysis of alumatrane and silatrane that could be other structure-directing agents in the system. Moreover, the mesoporous  $\text{AlPO}_4\text{-5}$ , SAPO-5, and flower-like SAPO were also used as catalyst support for Pt catalyst over the preferential oxidation (PROX) of CO reaction, showing a 100% CO conversion, indication that they are useful to completely remove CO contaminated in the  $\text{H}_2$ -rich feed gas as a fuel in proton exchange membrane fuel cells (PEMFC) to protect degradation of the platinum electrode.

## บทคัดย่อ

กาญจนา อัจฉริยจิต : การสังเคราะห์และการประยุกต์สารที่มีรูพรุนขนาดกลางชนิด  $\text{AlPO}_4\text{-5}$  และ  $\text{SAPO-5}$  ด้วยสารตั้งต้นเอเทรน โดยผ่านกระบวนการให้ความร้อนด้วยเครื่องไมโครเวฟ (Synthesis and Application of Mesoporous  $\text{AlPO}_4\text{-5}$  and  $\text{SAPO-5}$  by Atrane Precursors via Microwave Heating) อ. ที่ปรึกษา: รองศาสตราจารย์ ดร. สุจิตรา วงศ์เกษมจิตต์ 108 หน้า

สารซีโอไลต์ที่มีรูพรุนขนาดกลาง  $\text{AlPO}_4\text{-5}$  และ  $\text{SAPO-5}$  มีโครงสร้างชนิด AFI ถูกสังเคราะห์จากสารตั้งต้นอลูมาเทรน ไชลาเทรน และสารต้นแบบไตรเอทิลเอมีน ผ่านกระบวนการให้ความร้อนด้วยเครื่องไมโครเวฟ มีการศึกษาปัจจัยที่มีผลต่อการสังเคราะห์ ได้แก่ อัตราส่วนของสาร เวลาการบ่ม อุณหภูมิและเวลาของปฏิกิริยาในเครื่องไมโครเวฟ พบว่า สารซีโอไลต์ที่มีรูพรุนขนาดกลาง  $\text{AlPO}_4\text{-5}$  ที่สังเคราะห์ได้นี้ มีลักษณะเป็นแท่งยาวทรงหกเหลี่ยม นอกจากนี้ ความเข้มข้นของสารต้นแบบ ปริมาณน้ำในระบบ อุณหภูมิและเวลาในการให้ความร้อนส่งผลต่อรูปร่างและความเป็นผลึกของสาร การลดอุณหภูมิของเครื่องไมโครเวฟสามารถทดแทนได้ด้วยการเพิ่มระยะเวลาในการให้ความร้อนนานขึ้น การใส่ซิลิกาลงในระบบ เพื่อสังเคราะห์สาร  $\text{SAPO-5}$  มีผลให้ความยาวของผลึกหกเหลี่ยมสั้นลง เนื่องจากซิลิกาขัดขวางการโตของผลึกในแกนยาว ผลจาก TEM แสดงว่า สารซีโอไลต์นี้ประกอบด้วยผลึกซีโอไลต์ดั้งเดิม และสารรูพรุนขนาดกลางที่มีขนาด 10-100 นาโนเมตร และยังคงมีโครงสร้างชนิด AFI การสังเคราะห์สาร  $\text{SAPO}$  โดยไม่ใช้สารต้นแบบไตรเอทิลเอมีน พบว่า เกิดสารที่มีรูปร่างคล้ายดอกไม้ 6 กลีบ เนื่องจากสารไตรอัลคาโนเอมีนที่เกิดขึ้นจากปฏิกิริยาไฮโดรไลซิสของอลูมาเทรน และไชลาเทรนสามารถใช้เป็นสารต้นแบบในระบบอีกด้วย นอกจากนี้ สารซีโอไลต์ที่มีรูพรุนขนาดกลาง  $\text{AlPO}_4\text{-5}$  และ  $\text{SAPO-5}$  และสารประกอบที่มีรูปร่างคล้ายดอกไม้  $\text{SAPO}$  ถูกนำมาใช้เป็นสารรองรับสารเร่งปฏิกิริยาแพลทินัมเพื่อศึกษาประสิทธิภาพของความเป็นตัวเร่งปฏิกิริยาในปฏิกิริยาการเลือกเกิดปฏิกิริยาออกซิเดชันของก๊าซคาร์บอนมอนอกไซด์ในเซลล์เชื้อเพลิงที่ประกอบด้วยไฮโดรเจน สำหรับเชื้อแลกเปลี่ยนโปรตรอน (PEMFC) จากผลการศึกษาพบว่า ตัวเร่งปฏิกิริยาเหล่านี้สามารถใช้ในการกำจัดก๊าซคาร์บอนมอนอกไซด์ที่ปนเปื้อนได้อย่างสมบูรณ์ ซึ่งเป็นการป้องกันการเสื่อมคุณภาพของอิเล็กโทรดแพลทินัมได้อย่างดี

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