

SYNTHESIS OF Al-MCM-41/ZSM-5 COMPOSITE FOR OXIDATION OF
NORBORNENE TO NORBORNENE OXIDE

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*Specially dedicated to Mak, Ayah, Along and Angah,
No one else come close to each one of you.
For everything. I thank you.*

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ABSTRACT

Composite materials are engineered materials made from two or more constituent material with significantly different physical or chemical properties and the different material work together to give the composite unique properties. The incorporation of Al-MCM-41 and ZSM-5 produced micro-mesoporous composite which very significant to be used in the catalytic study. In this study, the microporous Al-MCM-41 and micro-mesopores Al-MCM-41/ZSM-5 composite have successfully by direct hydrothermal method. The resulting catalyst were characterized by X-Ray Diffraction (XRD), Fourier Transform Infrared (FTIR), Field Emission Scanning Electron Microscopy (FESEM), Transmission Electron Microscopy (TEM), Nitrogen adsorption-desorption isotherm analysis techniques, BET single point, Thermogravimetric Analysis (TGA) and ^{27}Al Magic Angle Spinning-Nuclear Magnetic Resonance (^{27}Al MAS NMR). Catalytic performance on Al-MCM-41/ZSM-5 composites has been carried out by oxidation of bulky molecule norbornene. Higher conversion was observed over Al-MCM-41/ZSM-5 composite 10 wt. % while the selectivity towards norbornene oxide are higher by using the Al-MCM-41/ZSM-5 composite 50 wt. % as catalyst. This is due to the increase of Bronsted acid side which lead to the increased of hydrophilic characteristic of the catalyst and resulting higher formation of norbornene oxide.

ABSTRAK

Komposit merupakan suatu bahan yang terhasil dari penyatuan dua atau lebih bahan yang mempunyai ciri-ciri kimia dan fizikal yang berbeza lalu menghasilkan bahan komposit yang memiliki ciri-ciri yang unik. Penyatuan antara Al-MCM-41 dan ZSM-5 menghasilkan satu bahan komposit berliang mikro-makro yang sangat sesuai untuk diaplikasikan sebagai mangkin. Di dalam penyelidikan yang dijalankan, Al-MCM-41 berliang macro serta komposit Al-MCM-41/ZSM-5 berliang mikro-makro, telah dihasilkan dengan menggunakan proses hidrotermal secara terus. Mangkin yang telah dihasilkan kemudiannya di cirikan dengan menggunakan pelbagai teknik termasuk Pembelauan Sinar-X (XRD), Spektroskopi Infra-Merah Fourier Transform (FTIR), Mikroskopi Elektron Pengimbas (FESEM), Mikroskopi Elektron Transmisi (TEM), Analisis Gravimetri Termal (TGA) dan Resonans Magnetik Nuclear (NMR). Tindakbalas bermangkin dengan menggunakan ZSM-5 serta komposit Al-MCM-41/ZSM-5 sebagai mangkin telah dijalankan ke atas tindakbalas pengoksidaan Norbornene yang merupakan molekul bersaiz besar. Hasil daripada tindakbalas ini, di dapati bahawa peratusan kadar penukaran adalah lebih tinggi apabila Al-MCM-41/ZSM-5 10 wt. % digunakan sebagai mangkin. Namun begitu, kadar pemilihan terhadap norbornene oksida adalah lebih tinggi apabila komposit Al-MCM-41/ZSM-5 50 wt% digunakan sebagai mangkin. Ini adalah disebabkan oleh peningkatan tapak asid Bronsted yang mengakibatkan peningkatan ciri-ciri hidrofilik pada mangkin serta peningkatan pembentukan norbornene oksida.