

Structural, Porosity and Morphological Changes of Montmorillonite Derived Porous Clay Heterostructures Prepared by the Starch Gel Template Method

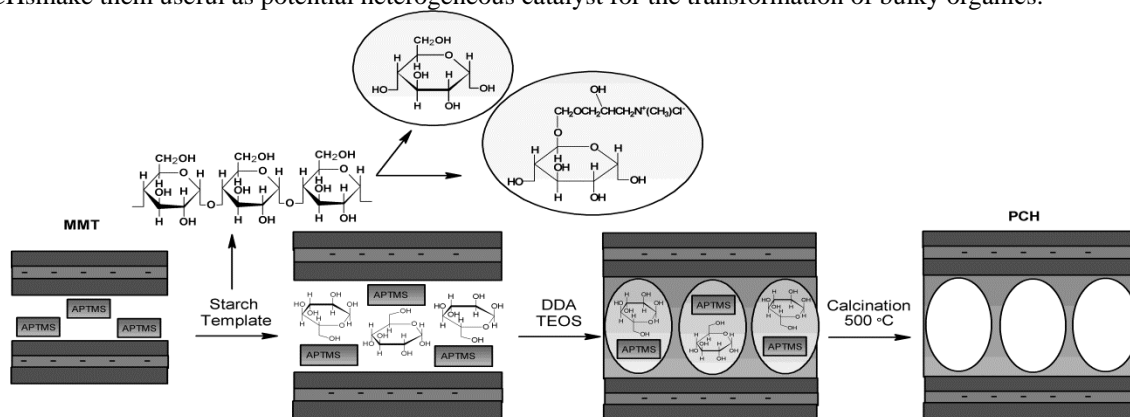
Salasiah Endud^{*1,3}, Norsahika Mohd Basir³, Zainab Ramli^{1,3}, Hendrik Oktendy Lintang^{1,2,3}

¹Novel Materials Research Group Nanotechnology Research Alliance

²Ibnu Sina Institute for Fundamental Science Studies

³Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

Clay minerals are natural hydrous aluminosilicate and possess a layered silicate structure that can be found in a number of soils. Montmorillonite (MMT) is one of the clay minerals have a surface area of $191 \text{ m}^2\text{g}^{-1}$ and has been used as a catalyst and adsorbent. However, their efficient use is limited due to low thermal stability and lack of porosity¹⁻³. In this work, mesoporous materials derived from raw MMT were obtained using the starch gel template method. Porous heterostructures (PCHs) were prepared by intercalation of cationic potato starch and hydrolysed potato starch as template, dodecylamine as co-template and tetraethylorthosilicate (TEOS) as silica pillar into the interlayer space of MMT. The effects of starch loading and aging temperature on changes of the structure, porosity and morphology of MMT in the formation of PCHs were investigated. The MMT derived PCHs was characterized by means of XRD, N_2 adsorption-desorption, pyridine adsorption, FESEM and FTIR spectroscopy. The XRD and FESEM analyses of the PCHs prepared using cationic and hydrolyzed starch showed a significant disordering of the MMT layer arrangement after treatment with the starch gel template. However, results of the nitrogen adsorption measurement showed the surface area has increased remarkably as high as $1000 \text{ m}^2\text{g}^{-1}$ with average pore diameters of 3.4 – 3.8 nm and pore volumes of 0.70 to $0.87 \text{ cm}^3\text{g}^{-1}$. Furthermore, the structural integrity of PCHs deteriorated slightly with increasing temperature but the porosity was maintained until up to $900 \text{ }^\circ\text{C}$. The FTIR spectra after pyridine adsorption showed that both raw MMT and PCHs possessed mainly strong Lewis acid sites. The acidity properties and high surface area of PCHs make them useful as potential heterogeneous catalyst for the transformation of bulky organics.



Scheme 1 Proposed Mechanism of the PCHs synthesis

1. Chae, H.J., Nam, I.S., Ham, S.W., Hong, S.B. *Catal. Today* 2001, 68, 31.
2. Gonzalez, F., Pesquera, C., Benito, I., Herrero, E., Poncio, C., Casascelli, S. *Appl. Catal.* 1999, A 181, 71.
3. Zhu, H.Y., Vansant, E.F., Xia, J.A., Lu, G.Q., *J. Por. Mater.* 1997, 4, 17.

Mrs. Norsahika Mohd Basir

Universiti Teknologi Malaysia (UTM), Malaysia

Phone: +60 127402554

E-mail: sahi kabasir88@gmail.com

Research interests: Inorganic Chemistry

2007-2010

B.Sc (Industrial Chemistry), UTM, Malaysia

2010-present

PhD Candidate UTM, Malaysia

