

Synthesis and characterization of saponite clays

R.J.M.J. VOGELS,¹ J.T. KLOPROGGE,^{2,*} AND J.W. GEUS³

¹Philips Lighting B.V., Frontstraat 4, 5405 AK, Uden, The Netherlands

²Inorganic Materials Research Program, School of Physical and Chemical Sciences, Queensland University of Technology, GPO Box 2434, Brisbane, Queensland 4001, Australia

³Department of Inorganic Chemistry, Utrecht University, P.O. Box 80083, 3508 TB Utrecht, The Netherlands

ABSTRACT

A new procedure has been developed for fast preparation of saponite clays under non-hydrothermal synthesis conditions of 90 °C and 1 atmosphere. Saponites were synthesized from a stoichiometric mixture containing Si/Al³⁺ gel, M²⁺-nitrate (M²⁺ = Mg, Zn, Ni, Co, or Cu), urea, and water within a few hours. The synthesis products were characterized with XRD, IR, TEM, XRF, N₂-physisorption, Al-EXAFS, and ²⁷Al- and ²⁹Si-MAS-NMR. Incorporation of Mg, Zn, Co, Ni, or a combination of these cations in the octahedral sheet, as well as controlling the Si/Al ratio in the tetrahedral sheet in the range between 5.67 and 39.0, could easily be established. Pure Cu-saponite could not be synthesized due to the preferred formation of chrysocolla, but a combination of Mg²⁺ and Cu²⁺ resulted in saponite formation. The chemical composition strongly influences the textural properties of the saponites. It is possible to prepare saponite samples of a specific surface area and pore volume of 100 to 750 m²/g and 0.15 to 1.05 mL/g, respectively. The lateral size and the amount of stacking of the saponite platelets could be influenced by the composition, synthesis duration, and amount of urea. The new synthesis procedure provides an easy way to prepare large quantities of saponites with far-reaching control on the texture as well as the composition.