

STRUCTURAL AND MORPHOLOGICAL INVESTIGATION OF SODIUM DODECYL SULFATE (SDS) - DIRECTED LINDE TYPE-A (LTA) ZEOLITE SYNTHESIZED AT VARYING CRYSTALLIZATION TEMPERATURES

M.D.R. Perera^{1*}, R.A.L.R. Amarasena¹, W.M.A.T. Bandara², R. Weerasooriya¹ and I.P.L. Jayarathna¹

¹National Institute of Fundamental Studies, Kandy, Sri Lanka

²Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka

*dilini.pe@nifs.ac.lk

Recently, nanocrystalline LTA-type zeolites have attracted much research attention due to their unique and promising functioning in a wide area of applications like catalysis, gas adsorption and separation, and medicinal applications. However, obtaining morphologically controlled LTA nanocrystals is a complicated but necessary task since the morphology of LTA crystals substantially influences the performance of their applications. This study aimed to investigate the structure-directing ability of sodium dodecyl sulfate (SDS), an eco-friendly anionic surfactant for forming nanocrystalline LTA zeolites with controlled morphology at varying crystallization temperatures. Following the microwave crystallization approach, synthesis was carried out at 100, 110, 130, and 150 °C crystallization temperatures with 900 W for 3 h, starting from the gel solution with the molar ratio of 5.5 Na₂O:1.0 Al₂O₃:4.0 SiO₂:190 H₂O: 0.2 SDS. The resulting materials were characterized by powder X-ray diffraction (PXRD) and scanning electron microscopic (SEM) techniques for an in-depth understanding of their structure and morphology. The PXRD results confirmed the successful synthesis of LTA zeolites at all four temperatures. However, with the increase in crystallization temperature, the phase purity tends to decrease due to the formation of hydroxysodalite (HS) impure phases at elevated temperatures (130 °C and 150 °C). A remarkable decrease in the crystallinity (80.2%) was observed for the sample crystallized at 130 °C but had the lowest average crystallite size (78 nm). Moreover, SEM monographs revealed the formation of the spheroidal “cotton-ball” structure of HS on surfaces and along with cubic crystals of LTA zeolite and crystal defects confirmed by the deeply truncated edges with rough crystal surfaces predominated at both higher temperatures. Accordingly, the study concludes that the best suitability of 100 °C crystallization temperature for the LTA synthesis is to have a controlled morphology with the highest crystallinity, with the aid of SDS.

Keywords: LTA zeolite, Morphology, Nanocrystalline, SDS, Structure directing