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SYNTHESIS AND STUDY OF STRUCTURE DIRECTING AGENTS ON STRUCTURAL PROPERTIES OF BORON MODIFIED ZEOLITES

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The ability to tailor specific framework structures and morphologies during zeolite synthesis is critical for their effective application in various processes, including catalysis, adsorption and separation. This study advances the synthesis of boroalumino zeolites with Linde Type A (LTA) and Faujasite (FAU) frameworks by developing novel techniques and the incorporation of boron atoms into the zeolites frameworks to better understand the impact of a structure-directing agent (SDA) on porous network formation and zeolite crystallisation. Boron-modified LTA and FAU zeolites were successfully synthesised with the B:Al ratio varying from 100 to 0 using microwave-assisted methods, both in the absence and presence of SDAs. Synthesised materials were characterised by powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), Raman microscopy, and Fourier transform infrared (FTIR) spectroscopy. Findings revealed that boron-modified LTA was formed in the absence of SDAs, whereas boron-modified FAU was produced when sodium dodecyl sulfate was used as the SDA. PXRD analyses revealed the formation of LTA and FAU zeolites in the synthesised materials. PXRD and SEM further revealed that increase in the B:Al ratio led to a reduction in crystallinity. However, further increasing this ratio did not favour the formation of pure LTA and FAU phases. Vibrational mode predictions via FTIR and Raman spectral studies revealed a prominent change, indicating the formation of 4-membered ring of LTA zeolite, while Faujasite's 6-membered ring was formed and the successful incorporation of boron was evidenced by corresponding shifts in the spectral bands. This study establishes foundational knowledge demonstrating that the presence or absence of SDAs, combined with increasing the B:Al ratio, leads to the formation of different zeolite types exhibiting low crystallinity.

Keywords: Crystallisation, Microwave-assisted synthesis, Morphology, Structure directing agents, Zeolite