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Influence of boron incorporation on the properties of faujasite zeolites

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Partial isomorphous substitution of aluminum with tri- and tetravalent atoms in zeolite framework tetrahedral positions (T-atoms) is an effective method for tailoring zeolite properties and enhancing their catalytic performance. The primary objective of this study is to investigate the influence of boron incorporation on the particle size, morphology, and crystallinity of Faujasite (FAU) zeolites. In this study, Boron-aluminum substituted Faujasite ([B]-FAU)-type zeolites were synthesized using a microwave-assisted method and sodium dodecyl sulphate as template, with a molar composition of 4 SiO_2: y H_3BO_3: x Al_2O_3: 5.5 Na_2O: 0.2 SDS: 190 H_2O, where y and x values were adjusted to achieve the desired boron and aluminum ratios for each sample. The obtained materials were characterized using various techniques: Powder X-ray Diffraction (PXRD), Scanning Electron Microscopy (SEM), Infrared (IR) Spectroscopy as well as Raman Microscopy. PXRD and SEM analyses revealed a trend of decreasing crystallinity in the FAU-type zeolites as the concentration of framework boron (B^{3+}) increased. This suggests that higher levels of boron substitution negatively impact the structural ordering of the zeolite material. FT-IR and Raman spectroscopy confirmed the presence of six-membered rings in the [B]-FAU zeolites. Specifically, a higher proportion of boron atoms were observed to be integrated into framework-related deformed hexagonal structure within [B]-FAU zeolites. The incorporation of boron into FAU zeolite with structure directing agents, results in reduced crystallinity of the B/Al-FAU crystallites compared to unsubstituted FAU, where high boron concentrations can create defects within the crystal structure which act as nucleation sites for amorphous phases. Despite this reduction in crystallinity, the fundamental structure of the FAU zeolite remains unchanged, as the boron atoms are embedded within its framework.

Keywords: *Borosilicate, characterization, microwave-assisted, sodium dodecyl sulphate, structure*