
Acid sites confinement in micro/mesoporous Y zeolite revealed from in situ IR monitoring of tri-tert-butylpyridine diffusion

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Résumé

The zeolite faujasite is widely used in catalytic applications. The as-synthesized zeolite must be dealuminated by steaming at high temperatures and/or acid leaching to prepare a more stable form, the so-called ultrastable Y (USY). During this treatment, framework Al atoms responsible for Brønsted acidity are removed and mesoporosity is created. These mesopores are very useful for improving the transport properties within the crystal, but they are generated at the expense of initial micropores, leading to a hierarchical meso/microporous material with diminished acidity. The challenge in catalyst development is to find the best compromise between improving transport within the crystal and preserving acidity. We thought that the best method to characterize at the same time the concentration and the accessibility of acid sites was to use the adsorption of a very bulky base. Its adsorption on the acid sites provides the driving force for diffusion, but the diffusion into the micropores is very slow, if the size of the base exceeds the size of the pore apertures. This perfectly reflects what is happening in the catalytic conversion of bulky molecules. In the present work, we used tri-tert-butylpyridine molecule (TTBPy, kinetic diameter 1.1 nm vs. 0.74 nm pore aperture in the faujasite structure) as a bulky base and followed its adsorption in hierarchical faujasite zeolites by IR spectroscopy.

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