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ON THE LEWIS ACIDITY OF PROTONIC ZEOLITES

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Abstract

IR spectra of hydroxyl groups, adsorbed CO, pivalonitrile and pyridine on three H-MFI zeolite samples and on two H-Y faujasites are reported and discussed. Samples richer in Al (H-MFI ($\text{Si}/\text{Al}_2 = 30$) and H-Y ($\text{Si}/\text{Al}_2 = 5.1$)) show the presence of extraframework species and the presence of Lewis acidity together with Brønsted acidity. H-MFI with lowest Al content ($\text{Si}/\text{Al}_2 = 280$) does not show any extraframework species (EF) and only presents Brønsted acidity. H-MFI with intermediate Al content ($\text{Si}/\text{Al}_2 = 50$) possess very small amount of EF species and of Lewis acidity. H-Y with low Al content ($\text{Si}/\text{Al}_2 = 30$) does not show extraframework species but shows the presence of Lewis acidity together with Brønsted acidity. The role of extraframework material as carrier of Lewis acidity is confirmed. It is proposed that Lewis acidity of low Al-content H-Y can arise from framework tetrahedral Al ions, which can enlarge their coordination to five without any previous dehydroxylation. A support for this hypothesis is given by the reversible shift of the LF OH stretching band, whose extent depends on the strength of the basic molecules: this is certainly not due to a direct interaction of the OH groups responsible for the LF band, which are located in cavities (sodalite cavity and hexagonal prisms) where the molecular probes cannot access.

Keywords: protonic zeolites; acidity; Lewis sites; Pyridine; carbon monoxide; pyvalonitrile.

1. Introduction

Protonic zeolites represent the most important family of solid acids applied in the industry as catalysts [1]. Milestones in the application of zeolites have been the first assessment of their adsorption properties and the first synthetic preparation of mordenite by Barrer in the

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