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Analysis of coordination environment of aluminum species in zeolites by X-ray fluorescence, XAFS and EXEFS

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The coordination environments of Al species in zeolite NaY and HZSM-5, amorphous silica-aluminas (SA), and reference compounds were analyzed by means of X-ray absorption, extended X-ray emission fine structure (EXEFS), and high resolution X-ray fluorescence (XRF) spectroscopes. Al K-edge XANES spectra of NaY, HZSM-5 and SA (14wt% as Al2O3) were quite similar to that of AlPO4, aluminum species of which is tetrahedral. XANES spectra of six coordinated Al3+ species give higher absorption edge than those of four coordinated species by 2 eV or that of Al foil by 7 eV, and higher white lines. The EXEFS spectra of Al foil, alpha-Al2O3 and AlPO4 were similar to those of XANES spectra. EXEFS spectrum of NaY was similar to that of AlPO4, but the spectrum quality of HZSM-5 was not enough to discuss due to the low Al concentration. The clear chemical shift and changes in line-widths were observed in Al K-alpha spectra among four- and six-coordinated aluminum compounds recorded using a double-crystal spectrometer. All the XANES, EXEFS and XRF spectra of zeolite samples were corresponded to those of four-coordinated reference compound. It clearly shows that these three kinds of spectroscopic techniques are also useful for coordination environmental analysis of Al species as well as 27Al NMR.