Contribution ID: **56** Type: **Oral Presentation**

Direct visualization of Al distribution inside zeolite crystals

Tuesday, May 21, 2024 8:50 AM (20 minutes)

Zeolites are porous material widely used as a catalyst, adsorbent in many industrial fields. Zeolite framework consist of mainly Si, Al and O, and it is important to control the position of Al at the atomic level. In addition, the size of zeolite particles are generally micron order, and the distribution of elements at that scale is expected to significantly affect the properties of zeolites. In this study, we aim to characterize zeolites in more detail by combining the visualization of atomic distribution at sub-micron scale by scanning electron microscopy and the evaluation of zeolite pore structure by a gas adsorption method. SEM is widely used as a tool to observe surfaces and microscopic shapes and sizes. Retarding methods have made it possible to observe the topmost surface structure of a sample with a resolution of about 1 nm using low acceleration voltages less than 1kV [1]. In addition, it has become possible to obtain information on the internal structure of particles by forming a smooth cross-section using Ar ions [2], and to directly observe the compositional distribution inside the sample by combining this technique with the EDS method. In this study, visualization of aluminum distribution inside the zeolites was performed by applying high-resolution FE-SEM and EDS mapping. Commercially available and synthesized zeolites with various Si/Al were selected as target material and Al-distribution inside zeolite particles were visualized. As shown in Figure 1, the Al distribution inside the zeolite particle is clearly observed. Furthermore, high-resolution Ar physisorption measurements were conducted to correlate with the detailed pore textural assessment. The origin of this Al-distribution will be discussed in the presentation.

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Session Classification: Tuesday

Track Classification: Oral Presentations