**Preparation and formation mechanism of AFX zeolite**

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**Highlights**

* Effect of hydrothermal synthesis time on the preparation of thee AFX zeolite was confirmed.
* The FAU zeolite could be completely converted to the AFX zeolite for 7 h.
* The shape of AFX zeolite is hexagonal cylinder with bipyramidal tips at each ends.

**1. Introduction**

Zeolite is a crystalline oxide composed of silicon and aluminum. Zeolite generally shows high chemical and mechanical stabilities. Moreover, since zeolite has regularly arrayed pores of 1 nm or less, they can selectively separate certain materials by the difference of their molecular diameters. Among them, AFX zeolite can be expected for N 2 (0.36 nm)/ CH 4(0.38 nm) separation because the AFX zeolite has the pore structure of 0.36×0.34 nm. However, the formation mechanism of the AFX zeolite has not been clarified and optimized the synthesis conditions. In this study, AFX zeolite was prepared by using 1,1’-(1,4-butanediyl)bis(1-azonia-4-azabicyclo[2,2,2]octane)dication (Dab-42+), and synthesis time for obtaining AFX zeolite was examined in detail.

**2. Methods**

A synthesis gel was prepared by mixing sodium silicate, deionized water, 40 wt % Dab-4Br2, 48 wt % sodium hydroxide, and FAU zeolite particles to be predicted molar composition. The obtained mixture was sealed in an autoclave and heated at 150 °C for 0 h, 3 h, 6 h, 7 h, 9 h, and 12 h. After the hydrothermal synthesis, the obtained solid product was filtered, washed, and dried at 80 ℃ overnight. These products were evaluated using X-ray diffraction and Field Emission Scanning Electron Microscopy（FE-SEM）.

**3. Results and discussion**

The FE-SEM images and XRD patterns of the products synthesized at each time (0 h, 3 h, 6 h, 7 h, 9 h, 1 2 h) are shown in Fig. 1 and Fig.2, respectively. As shown in Fig.2, XRD patterns of the products prepared for 0 h and 3 h were only FAU phase. In addition, no change for the shape and particle size of FAU zeolite was observed for the samples of hydrothermal synthesis of 0 h and 3 h, as shown in Fig. 1. For the XRD pattern of the product prepared for 6 h, the peak intensity of the FAU zeolite decreased and the peaks of the AFX zeolite were confirmed. Moreover, the crystals of hexagonal cylinder with bipyramidal tips of AFX zeolite with crystal sizes ranging from 2 to 3 μm were observed with FAU zeolite particles, as shown in Fig. 2. At first, the agglomeration of FAU zeolite particles was occurred and then it turned to AFX zeolites, as shown yellow circle in Fig.1. The products of 7 h hydrothermal synthesis, the peaks of AFX zeolite were only confirmed. In addition, crystal size and shape of these products were similar. This result suggests that the FAU zeolite could be completely converted to the AFX zeolite for 7 h in this condition.





**4. Conclusions**

Conversion of FAU zeolite as a starting material to AFX zeolite was confirmed at 6 h hydrothermal synthesis. In addition, after 7h hydrothermal synthesis, FAU zeolite completely converted to AFX zeolite.

**References**

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