
Thermally induced conversions of zeolite polymorphism

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Abstract

Zeolites are thermodynamically metastable crystalline aluminosilicates with framework type structures.[1] As such, the crystallization of zeolites often involves structural transformation (polymorphism) from one metastable structure to more thermodynamically stable structure. Many factors such as pH of the initial solution, alkalinity, counter ion used, water content, and temperature affect directly the zeolite crystallization, and these parameters can be adjusted to tailor zeolite size and crystal habit. But it's not fully understood how many of these parameters influence the kinetics and thermodynamics of zeolite nucleation and crystallization that contribute when the target is a zeolite structure with high free energy that easily could be transformed to an energetically more favorable phase.[2]

In the present work we follow the phase transformation process in template free precursor system, where five zeolites with BPH, FAU, GIS, SOD, JBW type structures are synthesized. By controlling the ratio of the counter ions (Na or K) in the initial composition and changing the synthesis temperature, the transformation from less stable zeolite BPH to more stable dense JBW zeolite was observed. This process was described by Ostwald rule of stages, wherein the more metastable structures are dissolved and recrystallized into more thermodynamically stable structures.

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