【Grant-in-Aid for Scientific Research (S)】

Elucidation of the origin of zeolite crystallization and innovation of production methods

Principal Investigator	The University of Tokyo, Graduate School of Engineering, Professor WAKIHARA Toru　Researcher Number:70377109
Project Information	Project Number : 23H05454　Project Period (FY) : 2023-2026 Keywords : Zeolites, Catalysts, Adsorbents, Ion-exchangers

Purpose and Background of the Research

●Outline of the Research

Zeolites are crystalline inorganic materials with regular molecular-sized pores and are widely used as catalysts, adsorbents, and ion-exchangers. However, their formation mechanisms are still largely unexplored, and their properties are far from being designed. In this study, the origin of zeolite crystallization will be elucidated using state-of-the-art analytical techniques and novel synthesis methods, we aim to create high-performance zeolites and innovate manufacturing methods.

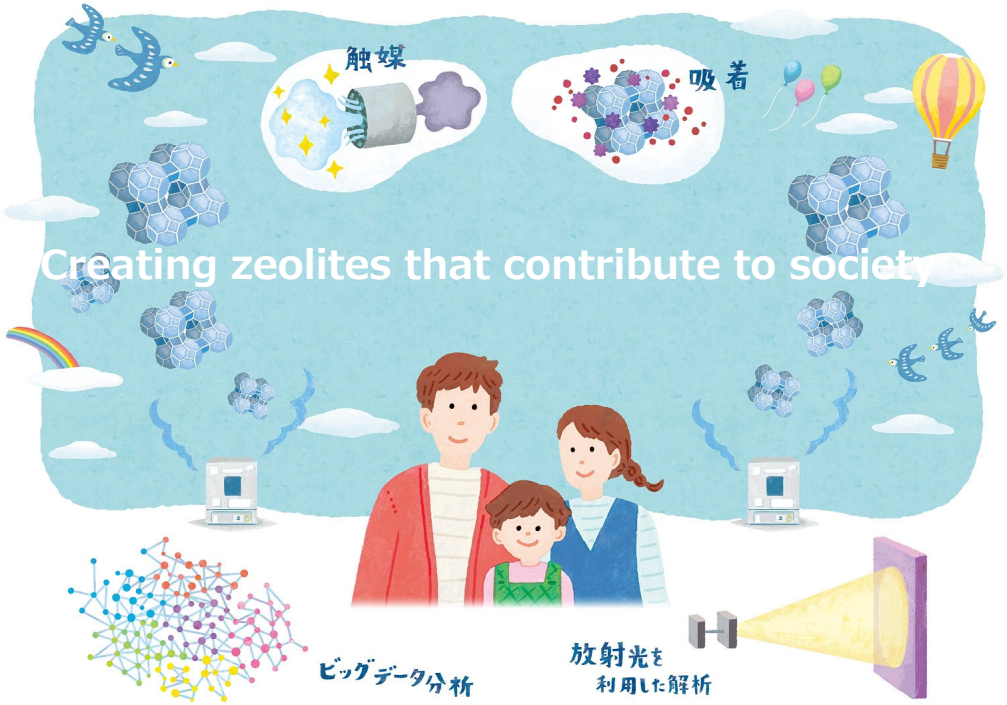

Figure 1. Outline

●How Zeolites Crystallize

Zeolites are synthesized by a method called hydrothermal synthesis. What is happening under high-temperature and high-pressure synthesis conditions is still largely unknown and requires state-of-the-art measurement technology using synchrotron radiation.

●How can zeolites be designed?

The development of zeolites with ultra-precisely controlled atomic arrangement is expected to enable the creation of zeolites with unparalleled high performance and high durability. In order to achieve this, a new synthesis method that enables zeolite design is needed. In addition, it is necessary to be able to synthesize zeolites in a short time and from low-cost raw materials in order to use the created high-performance zeolite in the world.

Figure 2. Zeolite structures and crystallization

Expected Research Achievements

●Understanding the mechanism of zeolite nucleation and how to control it

To understand the relationship between the amorphous structure formed during zeolite crystallization and the structure of the resulting zeolite, and to control crystallization.

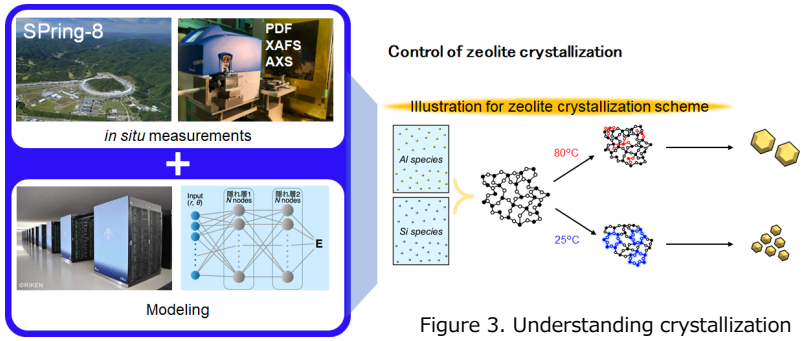

Figure 3. Understanding crystallization

●Atomic arrangement control of zeolite

Controlling the position of atoms in zeolites at the atomic level is expected to create new nanospaces and improve the catalytic and adsorption performance.

●Development of Inexpensive Synthesis Methods

It is essential to develop ultra-fast synthesis methods and synthesis methods that do not use expensive raw materials for social implementation.

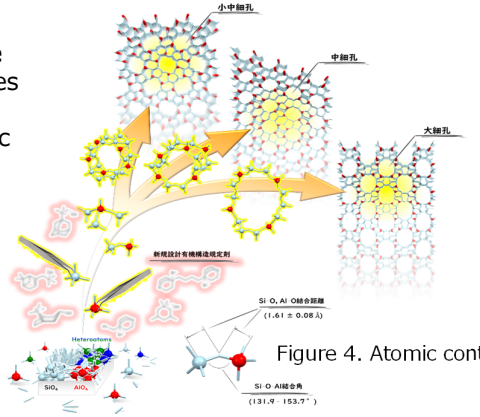

Figure 4. Atomic control

Homepage Address, etc.	http://www.zeolite.t.u-tokyo.ac.jp/