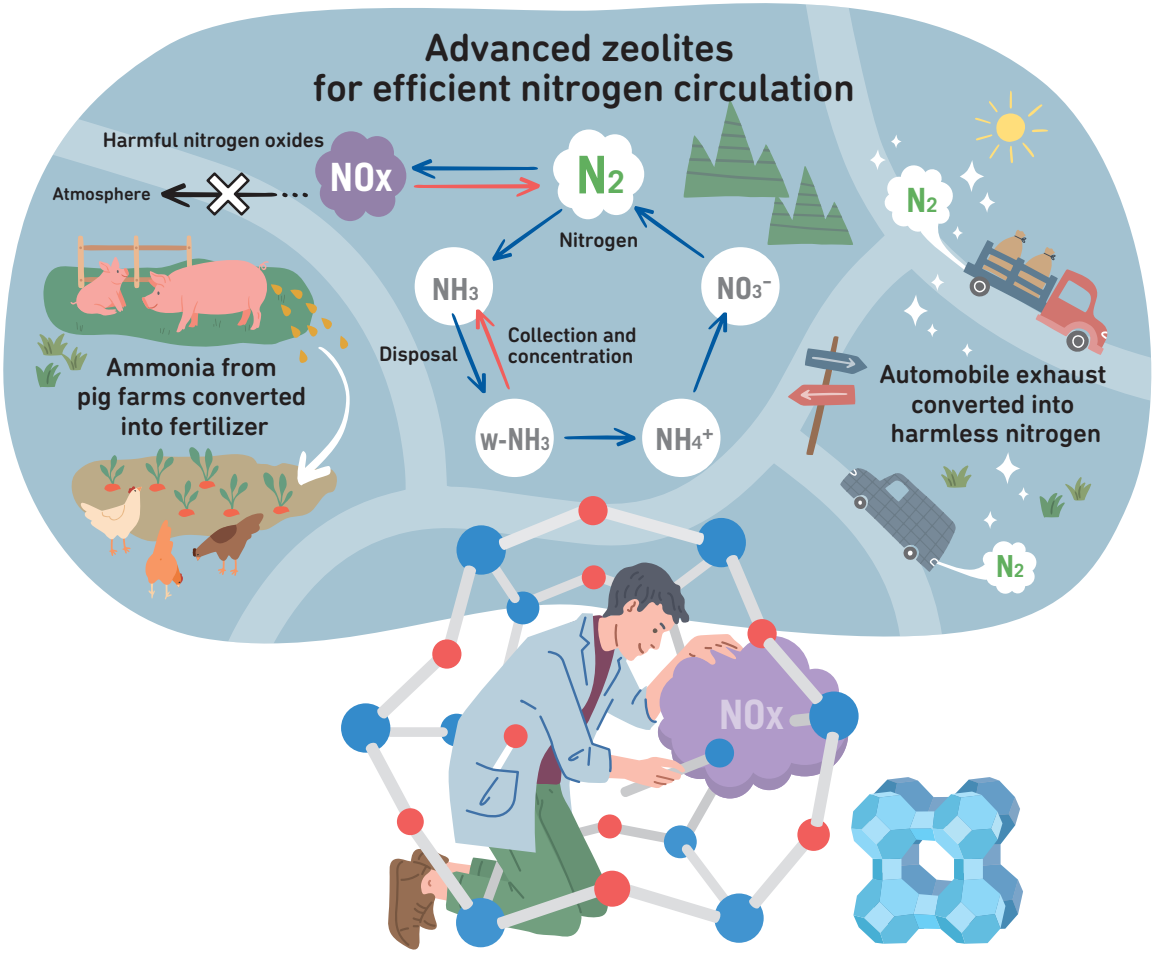
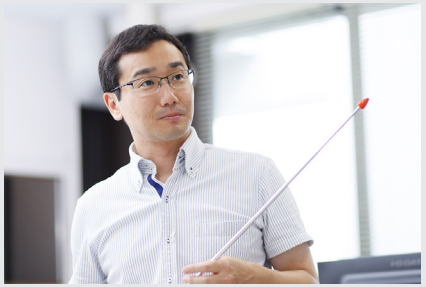
13 PROJECT

Working in Nanoscale Space to Perfect Zeolite for a Nitrogen-Recycling Society

Developing Technologies for Recovery and Removal of Dilute Reactive Nitrogen

Nitrogen gas (N_2) circulates naturally in the atmosphere, in land, and in the oceans in various forms. However, human activities such as the use of chemical fertilizers in agriculture and the burning of fossil fuels have disrupted the nitrogen cycle's balance by increasing the amount of harmful nitrogen oxides in the atmosphere. This has led to air pollution and climate change and impacts the global environment. We are researching nitrogen circulation systems using ***zeolite*** and other materials that do not place such burdens on the environment.





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Ending the Era of Reactive Nitrogen's Harm on Earth

What is reactive nitrogen? This is a general term for forms of nitrogen that are easy to utilize by organisms. Since most cannot make use of atmospheric nitrogen directly, they use it in the form of reactive nitrogen. For example, the proteins in food contain reactive nitrogen. On the other hand, ammonia (NH_3) in chemical fertilizers and nitrogen oxides emitted by burning fossil fuels also contain reactive nitrogen. Reactive nitrogen is deeply involved in our lives, but it is the unnatural, excessive, human-produced reactive nitrogen that causes environmental problems.

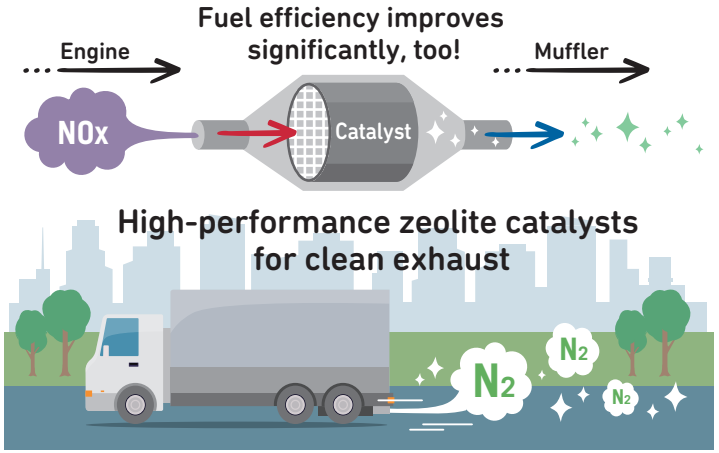
Working in Nanoscale Space to Perfect Zeolite for a Nitrogen-Recycling Society

» Zeolite Works in Multiple Ways

Many people may have never heard of zeolite before, but it is actually used in common products such as detergents and deodorizers. A number of zeolites have pores identical in size to molecules like nitric oxide, nitrous oxide, and ammonia, and can trap these molecules or react with them to convert them into other molecules. Another feature of zeolites is that they are easy to synthesize and their structure can be modified for specific applications. We plan to make full use of zeolite to take on the challenge of reducing human-caused excess reactive nitrogen.

» Working Toward a Society That Doesn't Emit Reactive Nitrogen

Zeolites are conventionally used as catalysts in automobiles. However, they suffer from temperature range limitations and durability issues and emit nitrous oxide when they age and deteriorate. This can be solved by creating zeolites that are precisely tuned at the atomic level. Another application is their use in agriculture. Incorporating zeolite-like substances in ammonia recycling systems allows ammonia generated at pig farms to be converted into fertilizer. Yet another use for zeolite is in sewage treatment plants, where it can process harmful nitrogen oxides and turn them into harmless nitrogen. Adopting technologies to create zeolites can enable the development of a nitrogen circulating society where reactive nitrogen is reused as a resource, contributing to environmental restoration.



KEYWORD

Zeolite

This is a general term for porous crystalline aluminosilicates. Zeolites are used in many fields as catalysts and adsorbents. They feature tiny pores smaller than 1 nanometer (1 billionth of meter), and it is thought that zeolites with even smaller pores will be useful in achieving a nitrogen circulating society.

FUTURE VISION

2025 — Develop Advanced Zeolites

We will complete the development of zeolite that does not deteriorate even under harsh conditions, a long-standing challenge.

2027 — Complete the System's Constituent Components

We will complete the development of the ultimate denitrification catalyst and materials for the recovery of nitrous oxide and ammonium ions, and begin to promote the system. Social implementation of the technology is almost achieved. We will also complete the development of zeolites for various applications.

2029 — Zeolites Become Integral to Society

Finally, we will conduct user evaluations needed for social implementation of the process.

Implementation The University of Tokyo, National Institute of Advanced Industrial Science and Technology (AIST), Japan Fine Ceramics Center, Mitsubishi Chemical Corporation

Project Introduction Video https://www.youtube.com/watch?v=7pLatx5dgmg&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXaoo3