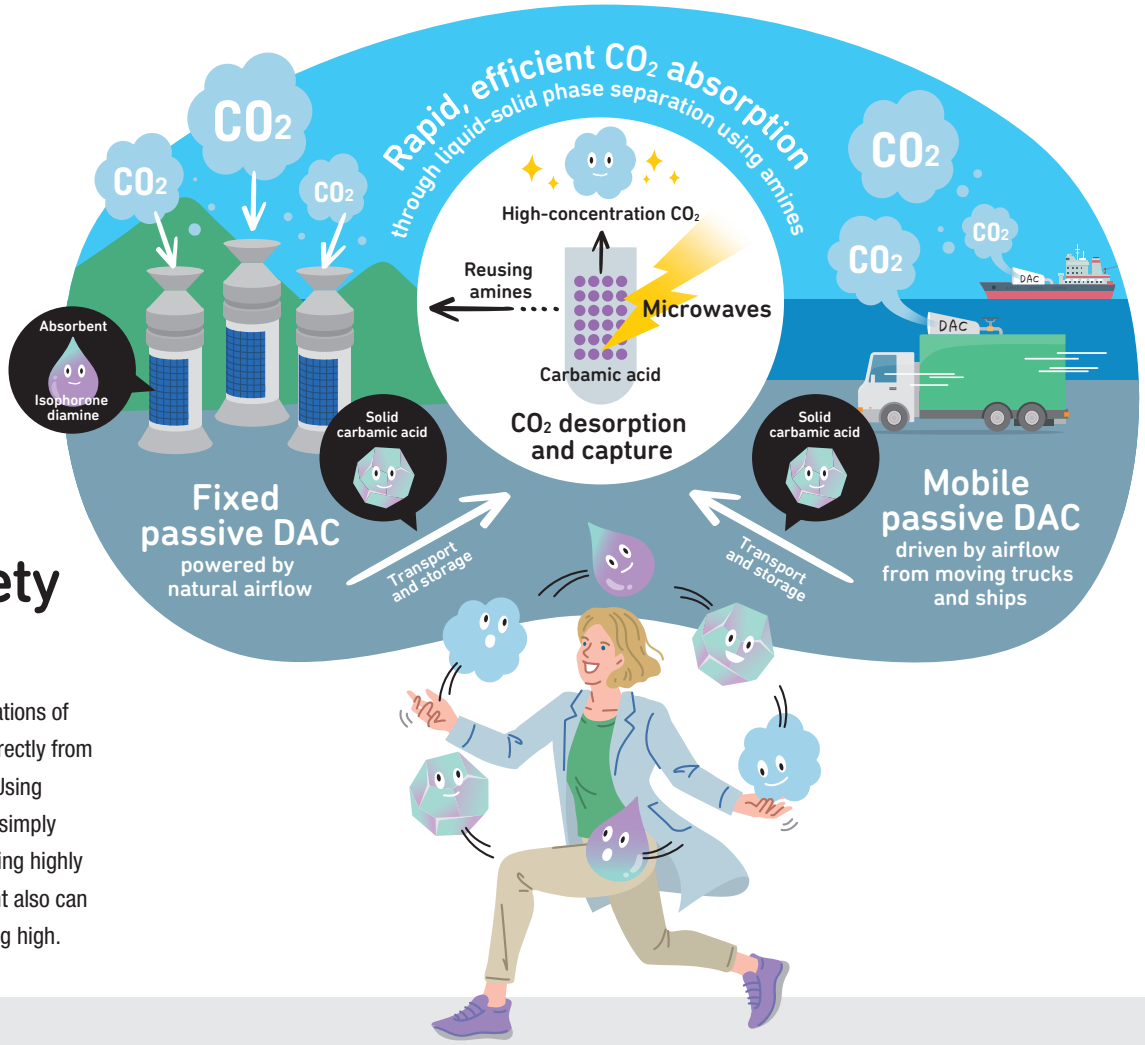
06 PROJECT

World's Fastest Carbon Capture System Extracts CO_2 from Ambient Air Future Applications to Promote Full-Fledged Carbon-Recycling Society

Research and Development of Passive DAC Technologies

No method of countering climate change is as effective as Direct Air Capture, or DAC. However, concentrations of CO_2 in ambient air were previously thought to be too low to allow the CO_2 to be captured efficiently and directly from the air. There is a substance called isophorone diamine that turns this conventional thinking on its head. Using isophorone diamine as an absorbent in DAC systems allows even low-concentration carbon dioxide to be simply and easily solidified for capture. The passive DAC system currently in development is capable of maintaining highly efficient CO_2 absorption for extended periods of time without any forced air flow. In addition, the absorbent also can be reused after absorption and release of the CO_2. Expectations for practical use of this system are running high.



Fateful Encounter with Key Compound in Achieving CO_2 Capture

Dr. YAMAZOE Seiji
Professor, Department of Chemistry,
Graduate School of Science, Tokyo Metropolitan University

We were initially researching DAC using catalysts, but in a stroke of luck we happened to hit upon isophorone diamine. We then decided to change direction and began to work on absorption and solidification of CO_2 without a catalyst. While our initial goal is to solidify and collect CO_2 efficiently, in the future, we envision taking this a step further. Solidified CO_2 can be stored for extended periods, remains stable in transport, and can be extracted when needed, making it a prime candidate in supporting a carbon-recycling society as an alternative to conventional fossil fuel resources. As this carbon resource is obtained from the atmosphere, it has been dubbed SkyCarbon®.

Cool Earth | Clean Earth

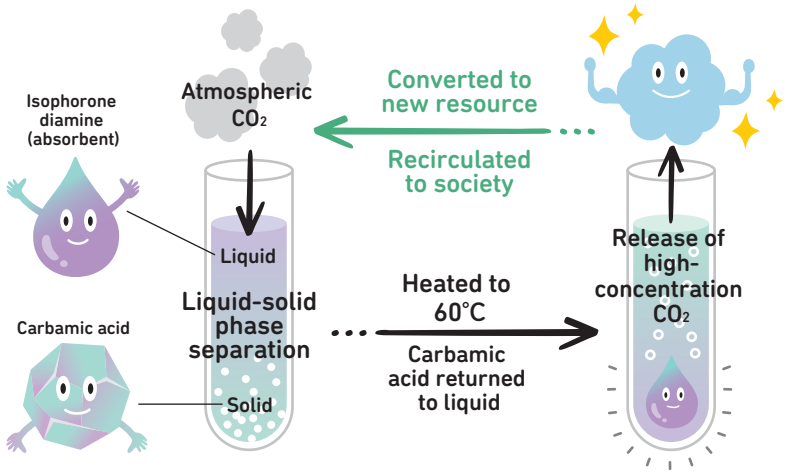
World's Fastest Carbon Capture System Extracts CO_2 from Ambient Air Future Applications to Promote Full-Fledged Carbon-Recycling Society

» Presenting the Optimal CO_2 Absorbent

This passive DAC system captures air from all directions using only natural air flow, with no additional energy input required, resulting in a superior system that captures CO_2 without the additional costs required in forced-air systems. CO_2 absorbents used thus far have been hampered by slow reaction speeds and inefficiency, but we discovered that through the mechanisms of ***liquid-solid phase separation*** using isophorone diamine as the absorbent, CO_2 can be captured extremely efficiently and collected as a stable solid for storage and transport. This system has achieved capture rates among the highest in the world.

» The Earth's Atmosphere: A Resource Repository

Microwaves of wavelengths near those used in microwave ovens can be produced using electricity, with the further advantage of being able to heat objects efficiently and be targeted with pinpoint accuracy. Microwaves heating captured CO_2 separates the CO_2 from the absorbent, allowing recovery of nearly 100% pure CO_2. The highly concentrated captured CO_2 is repurposed when converted into energy, plastic materials, or other products. Furthermore, since the absorbent also can be reused after separation from the CO_2, completing development of this system can lead to a full-fledged carbon-recycling society. Incidentally, this DAC system can be installed in cities and other locations to gather ambient air from any direction, and it can also be used with cars and ships, so the system may become a common sight in societies of the future.



KEYWORD

Liquid-Solid Phase Separation

This is a process of separating substances in a mixture, for example the separation of water and oil in salad dressing.
This phenomenon causes the liquid absorbent to separate from the solid material that has absorbed CO_2, giving the absorbent increased CO_2-absorbing capacity and allowing capture of even more low-concentration atmospheric CO_2.

FUTURE VISION

2025

Gather Knowledge and Create a Test System

We will first create a test system bringing together various technologies from the universities and companies involved in the project.

2027

Demonstrate Effectiveness with Twin Towers

We will verify the performance of a midsized, fixed passive DAC system using two towers: an intake tower and an exhaust tower. The goal at this point is to determine the prospects for achieving carbon neutrality or carbon negativity.

2029

Make DAC a Common Sight

We plan to complete the development of a system capable of capturing 100 kg of CO_2 per month using a single tower, integrating the functions of the intake and exhaust towers. This DAC system will be installed on a university campus.

Implementation Tokyo Metropolitan University, Taikisha Ltd., Pantaray Co., Ltd., Nagaoka University of Technology, Kojima Industries Corporation, Kyushu University

Project Introduction Video https://www.youtube.com/watch?v=FRsc5-EJGLE&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXaoo3