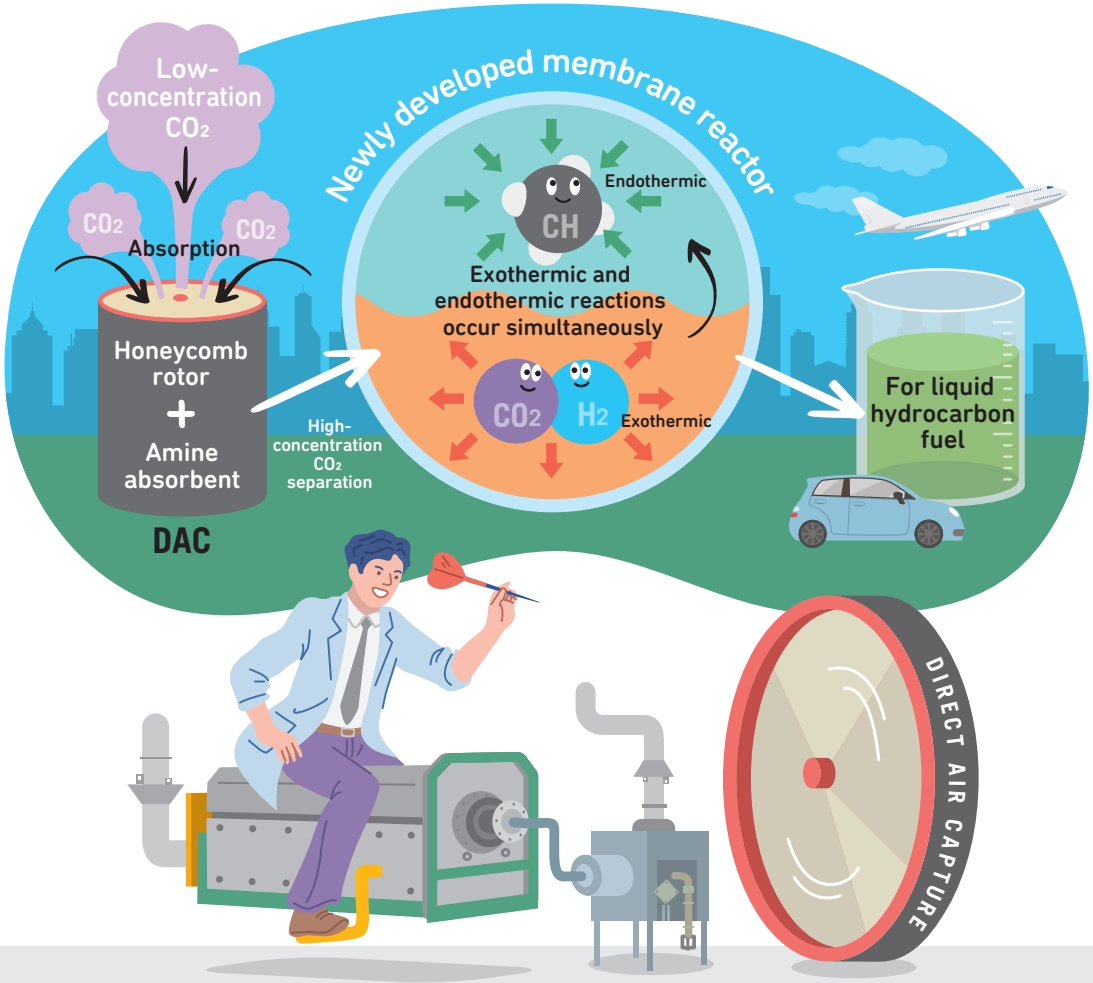
01 PROJECT

Effective Capture of Low-Concentration CO_2: Absorbents and Thermal Control Are Key

Development of Highly Efficient Direct Air Capture (DAC) and Carbon Recycling Technologies

Trends indicate that CO_2 emissions from industrial activities account for the greatest increase in greenhouse gases (GHGs) over the past thirty years. Direct Air Capture, or DAC, is viewed as a possible way to deal with this problem. These systems recover CO_2 directly from the atmosphere, but performance depends on the CO_2 absorbent used, and the process of separating and concentrating the captured CO_2 requires large amounts of thermal energy. We are working to maximize DAC capacity and develop the technologies that will power this innovative solution to the global warming crisis.



Partnering With the Earth to Create an Ideal Future With New Technologies

Dr. KODAMA Akio
Professor, Institute for Frontier Science Initiative, Kanazawa University

Separating garbage from recyclables is now an established practice for many of us. Development of technologies for more efficient fuel and energy use has also made progress. However, I find the idea of promoting all these efforts and technologies as particularly “environmentally friendly” rather odd. After all, the Earth—on its own—is self-repairing and protects the ecosystem from the burdens we place on it. What we should aim to do is rethink our dependence on the Earth’s generosity and the human activities that continue to burden the Earth, using new technologies in harmony with nature.

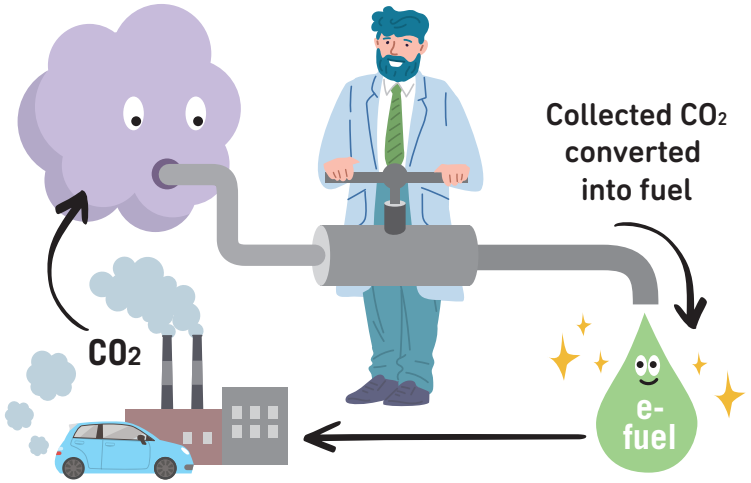
Effective Capture of Low-Concentration CO_2: Absorbents and Thermal Control Are Key

» Newly Developed Amine + Honeycomb Structure Boosts DAC

The heart of this DAC system is an amine-coated CO_2 absorbent. The ***amines*** used currently have high absorption capacity, but they also have disadvantages. For one, they require large amounts of thermal energy to separate and concentrate CO_2. Secondly, absorption nearly stops after oxidative degradation. But our extensive research has led to the development of an amine that overcomes these two challenges. It was also discovered that if a highly breathable porous honeycomb shape is used, the energy required for moving the air is reduced, and that increasing the application area of the amine improves the absorption rate to allow for more rapid CO_2 capture.

» Aiming for Zero Emissions With Synthetic Fuels

The high-concentration CO_2 that we capture is utilized by partnering organizations. One application is converting the CO_2 to liquid hydrocarbon fuel through hydrogen reactions. Also called synthetic fuel or e-fuel, this alternative to petroleum-based fuels can be used in internal combustion engine vehicles. This next-generation fuel boasts high energy density, can be handled by conventional facilities like gas stations, and can be produced even in resource-poor countries. It can also be converted to e-methane, a synthetic natural gas alternative. Since the CO_2 emissions released while using e-fuel and e-methane represent CO_2 captured from the atmosphere, the net global warming potential is zero.



KEYWORD

Amine

This alkaline chemical substance is composed of carbon and nitrogen. It absorbs CO_2 well, but it can also release CO_2 due to heating or pressure loss. The molecular structure is easy to design, which makes it possible to create amines for various applications.

FUTURE VISION

2025

Exhibit DAC at Expo 2025 Osaka, Kansai, Japan

A full-scale DAC system will be exhibited at Expo 2025 in Osaka. In addition to conducting demonstration experiments to identify operational problems, we will analyze the energy costs of CO_2 separation and recovery.

2027

Repeated Inspection and Verification of DAC System

After analyzing the data collected from the exhibition at Expo 2025, we will scale up the system and conduct repeated demonstration experiments to verify the scale and performance in terms of real-world social implementation.

2029

Establish and Evaluate DAC Technology

After the technology is established, our goal will be to build a DAC system while taking into account the energy costs for CO_2 separation and capture. We will also collaborate with other project teams and enterprises to evaluate the effectiveness, practicality, applicability, and economic impact of the system.

Implementation Kanazawa University, Research Institute of Innovative Technology for the Earth (RITE)

Project Introduction Video https://www.youtube.com/watch?v=hblRUkJjlx8&&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXaoo3