Environment

CO_2 capture, storage and release technology using photoenergy

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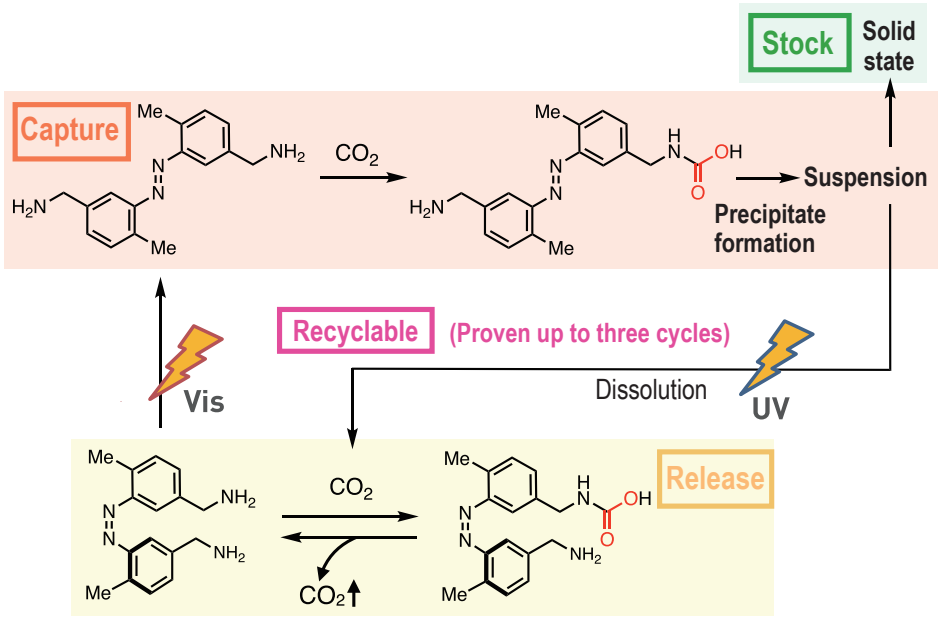
Purpose of Research

In the Earth's carbon cycle, atmospheric CO_2 has been greatly increasing. Unless appropriate measures are taken to reduce atmospheric CO_2, CO_2 may increase further in the atmosphere to exacerbate global warming and deplete fossil carbon resources. To resolve the increase of the atmospheric CO_2, there is demand for developing technologies that capture CO_2 and convert it into usable materials as carbon resources with net zero CO_2 emissions. With the aim of demonstrating the technologies, in this research we have developed a chemical absorption method that uses photoenergy to capture, storage and release CO_2.

Summary of Research

In this research we have developed a molecule that changes its structure with optical photoenergy. Photo-irradiation switches the chemical state of this molecule reversibly between two states: one is outstanding at absorbing CO_2 and the other is poor. Using this property, we have succeeded in efficiently controlling the capture, stock and release of CO_2 by photo-irradiation arbitrarily and repeatedly.



Comparison with Conventional or Competitive Technologies

- [Conventional situation] Energy-consuming processes such as heating/decompression are required to release CO_2, which induces problems such as indirect CO_2 emissions via consumption of fossil energy, high energy cost, and limited available treatment facilities.
- [This technology] It uses limitlessly available sunlight without consuming exhaustible fossil energy to comprehensively reduce CO_2.

Expected Applications

- Capture/storage of CO_2 from flue gas of factories such as thermal power plants and from the atmosphere
- Promotion of growing plants with captured CO_2 (plant factories, plastic greenhouses and plant culturing)
- CO_2 cycling in living spaces (closed environments, underground spaces, submarines and space stations)

Challenges in Implementation

- Search for molecules more efficient at CO_2 capture/release and stabler in CO_2 storage (especially improvement of CO_2 release efficiency)
- Development of a system that uses the renewable energy of sunlight
- Expansion of the operating scale
- Development of a prototype equipment (instrument development)
- Improvement of analysis accuracy (equipment development)

POINT

- **Achieves CO_2 capture/release without heating/decompressing process → Reduction in CO_2 recycling costs and expansion of applications of CO_2 capture/utilization technologies**
- **CO_2 recycling technology that does not use exhaustible fossil energy**
- **Enables comprehensive CO_2 reduction in the atmosphere, leading to climate change mitigation**

What We Expect from Companies

- Collaboration in development of separation/focusing techniques for using UV/visible light in sunlight
- Joint development of a prototype equipment
- Improvement of analysis accuracy (joint development of an equipment)
- Supply of molecules in large amounts for practical use

Future Developments

Improvement of the capture/release efficiency by optimizing the structure
Evaluation and improvement of durability
Development of a sunlight utilization system
Completion of a prototype equipment

■ Associated System: JST-Mirai Program
"Realization of Low-Carbon Society by creating Game Changing technology"
■ Intellectual Property: Japanese Patent Application No. 2019-036824
■ Sample: Available

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