革新的二酸化炭素分離技術と低温成形可能な再生可能資源由来高分子材料による低炭素社会への早期移行

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Research Background

■ **Global Warming and Climate Change** are among the most urgent environmental issues triggered by the increasing atmospheric concentration of greenhouse gases, such as CO_2.

■ Urgent actions are required to mitigate carbon emission, and CO_2 Capture, Utilization and Storage (**CCUS**) technologies are a potential solution.

■ Plastic production is one of the major CO_2 emission sources in industry sector, and **recyclability** of the plastics should be improved.

■ Environmental disruption caused by the end-of-life plastics is also serious issue as represented by "microplastics".

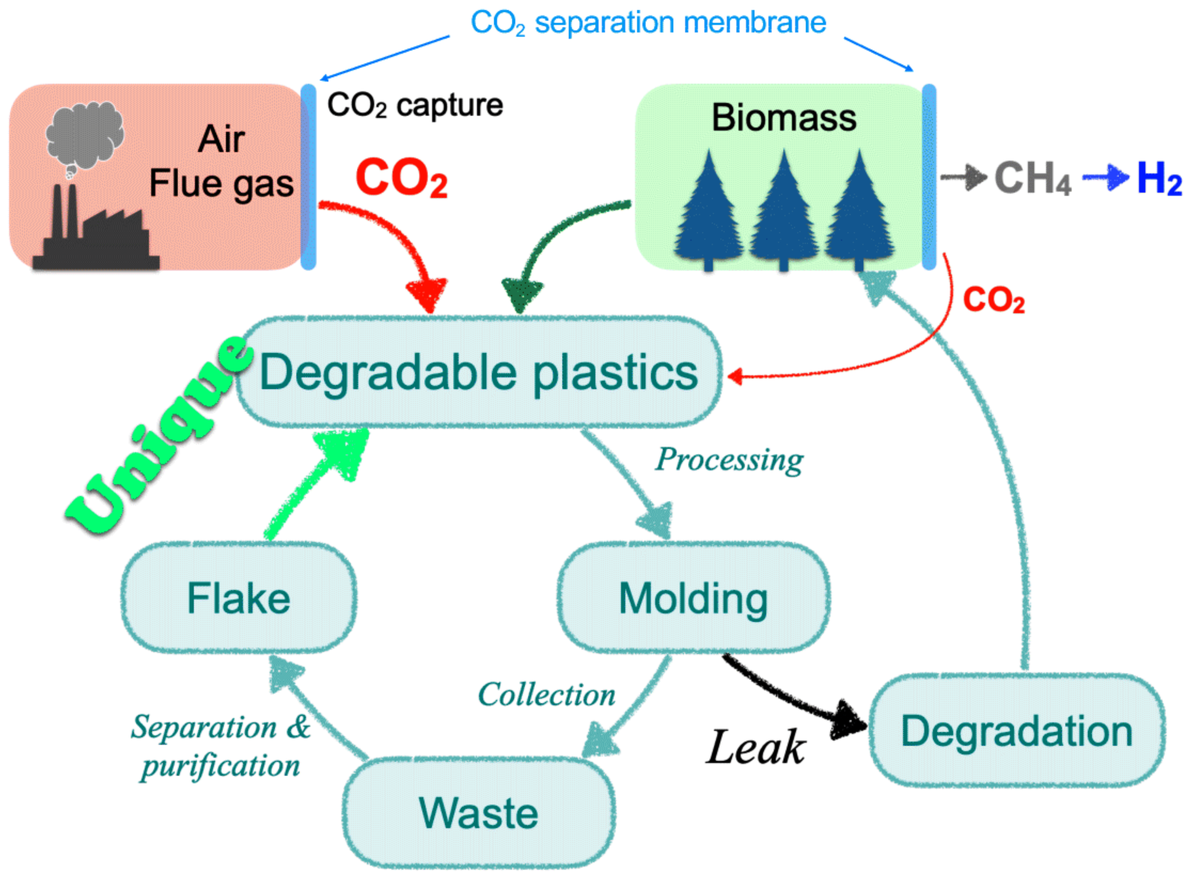


Figure 1. Plastic circulation toward sustainable society

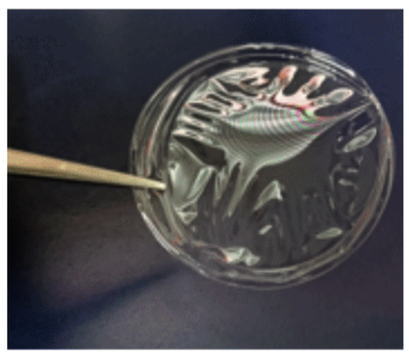
Objectives

■ Establishment of **effective CO_2 capture** technologies for implementation of CCUS

■ Development of **CO_2 separation membranes** with high gas permeability and selectivity

■ Creation of **environmentally benign plastic materials**, alternative to current non-degradable polymers

■ Development of polymeric materials from renewables with low-temperature formability, **degradable baroplastics**



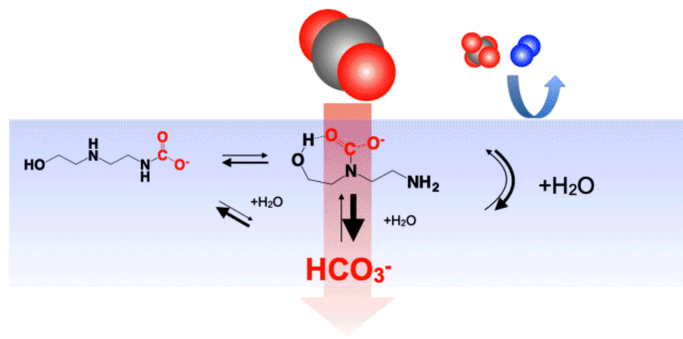


Figure 2. Amine-containing polymeric membrane and the mechanism of preferential CO_2 permeation

Research Topics

■ **CO_2 capture**
- Development of polymeric membranes for CO_2 capture
- Enhancement of gas separation properties
- Establishment of CO_2 capture processes by membrane separation
- Bench-/pilot-scale demonstration

■ **Degradable baroplastics**
- Elucidation of pressure-induced phase transition
- Tuning of material properties
- Substitution for current polymeric materials

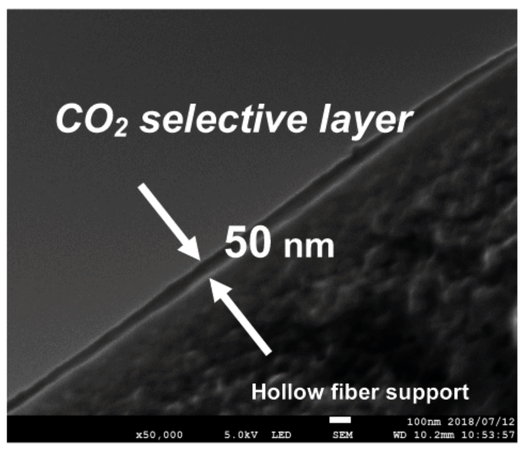
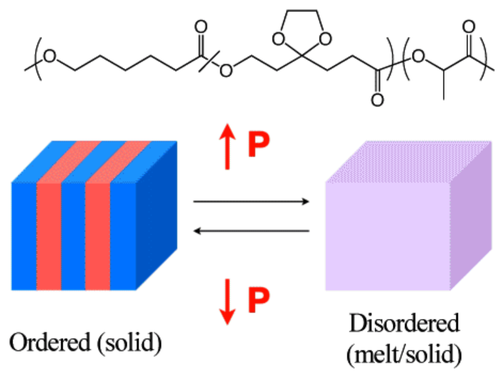


Figure 3. Hollow fiber membrane modules for CO_2 capture and a CO_2 selective layer formed on the inner surface of the hollow fibers

Applications

■ **CO_2 capture**
- CO_2 capture at various CO_2 emission sources
- Utilizations of the captured CO_2
- Carbon-free H_2 production

■ **Degradable baroplastics**
- Development of sustainable polymeric materials
- Matrices for drug delivery



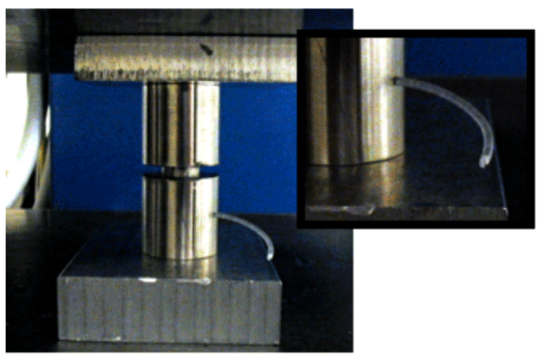


Figure 4. Room-temperature processable degradable polymers upon pressure-induced phase transition

Perspectives

■ Effective CO_2 capture can mitigate carbon emission to suppress the Climate Change. Bio-Energy with CCS and Direct Air Capture by membrane separation realize negative carbon emission.

■ Degradable baroplastics reduce energy consumption and carbon emission in processing. With the enhanced recyclability, the baroplastics are expected as a potential alternative to current plastics.

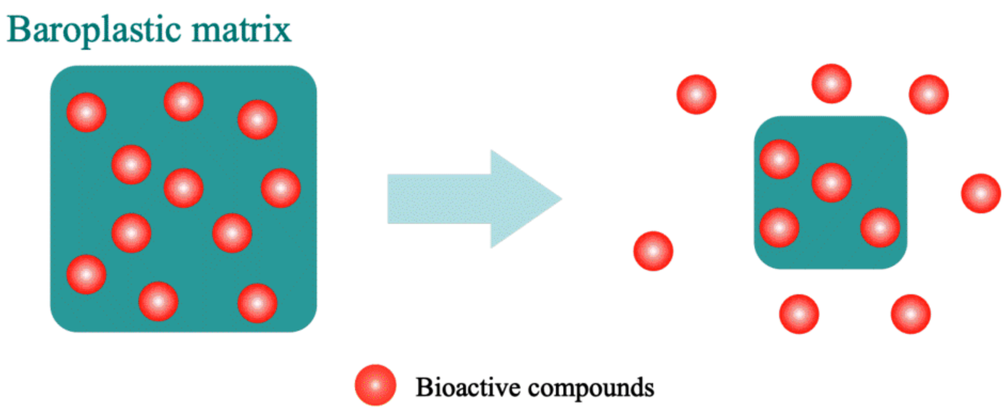


Figure 5. Controlled release of bioactive compounds upon degradation of degradable baroplastics

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