RENAISSANCE ENERGY RESEARCH CORPORATION

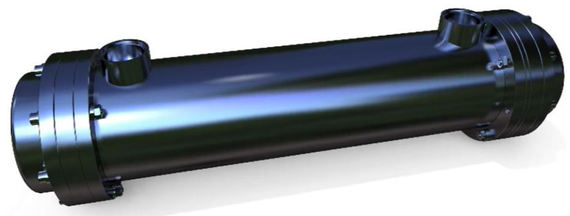
Innovative CO_2 membrane separation technology for a low-carbon society and High performance hydrogen production catalyst for hydrogen society

Business summary

1. Research and development of CO_2 separation membranes
Development of various gas permeable membranes such as CO_2 separation membranes and their application processes

2. Development of catalysts and process technology in the field of hydrogen/Consulting
Hydrogen production technology by steam reforming of hydrocarbons. Sales and licensing of catalysts and process technology, design and engineering of chemical processes and plants in the energy and hydrogen fields including fuel cells.

3. Research and development of biogas
Engineering of stable power generation system based on biogas by applying our CO_2 separation membrane technology



CO_2 separation membrane module

Hydrogen Production Process and Renaissance Energy Research's Catalyst Technology

Hydrogen Production Process

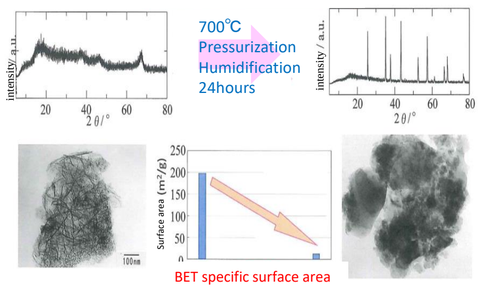
Oil / Natural gas → **desulfurization** → **steam reforming** $CmHn + H_2O \rightarrow H_2 + CO, CO_2$ Produces hydrogen by the reaction of hydrocarbons with steam → **CO shift reaction** $CO + H_2O \rightarrow H_2 + CO_2$ Reduces CO in reformed gas → products H_2 $(+CO_2)$ → Hydrogen utilization for fuel cell, hydrogen station, methanation etc.

- desulfurization: complete desulfurization — Ultra-high efficiency desulfurization catalyst; Desulfurization possible to ppb level
- steam reforming: Low S/C possible — Heat-resistant γ-alumina — High performance Ni catalyst
- CO shift reaction: High SV possible; Improved CO conversion — Low temperature activity improved catalyst
- products: Energy-saving CO_2 separation — CO_2 separation membrane (Recovered CO_2 to methanation)

Heat-resistant γ-alumina stable even in high-temperature and high-humidity environments

Improved heat resistance of γ-alumina

γ-Alumina has a high surface area but is unstable at high temperatures.
γ-alumina easily changes to α-alumina under humidified high temperature, and the surface area decreases.



	Normal γ-Al_2O_3	Normal heat resistance γ-Al_2O_3	Improved heat-resistant γ-Al_2O_3
fresh			
700° C, 24 h, 12 MPa, steam			
700° C, 24 h, 18 MPa, steam			
1200° C, 30 h, air			

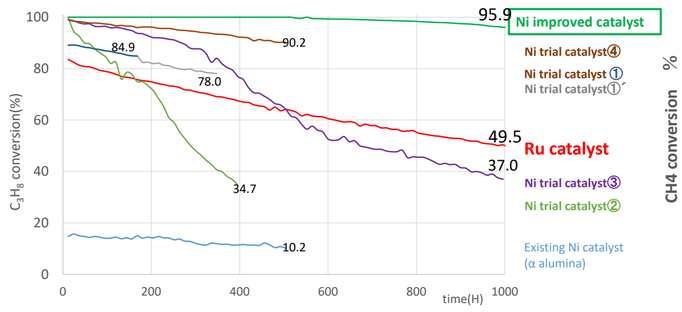
The heat resistance of the improved heat-resistant γ-alumina was greatly improved compared to the existing heat-resistant γ-alumina.

Hydrogen-related catalysts using heat-resistant γ-alumina

Steam reforming catalyst

Ru catalysts are used as steam reforming catalysts for fuel cells which require high performance. However, due to the resource limitation, we are developing Ni-based catalysts with performance comparable to Ru catalysts.

1000 hours continuous evaluation result



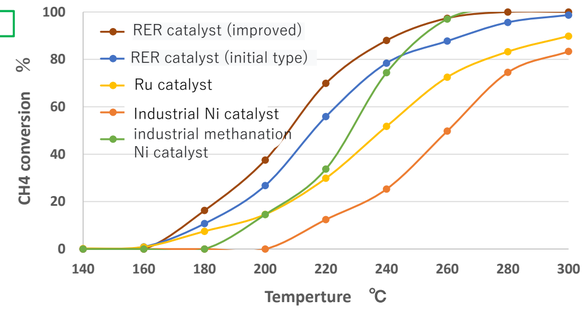
Improved Ni-based catalyst stably maintains reforming performance that greatly exceeds the Ru catalyst performance

Methanation reaction

Obtain methane from CO_2 and H_2

$$CO_2 + 4H_2 \rightarrow 2CH_4 + 2H_2O$$

This is expected as a carbon dioxide recycling technology.

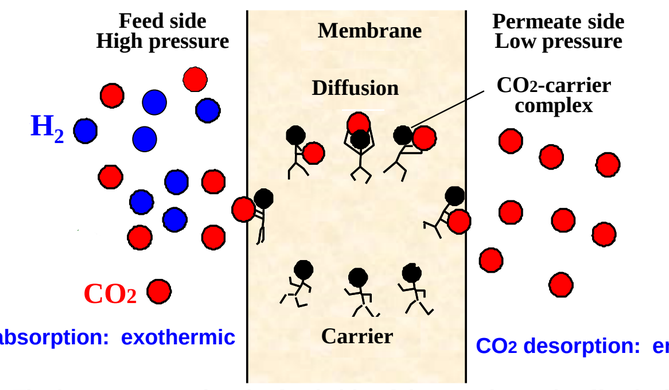


The RER developed methanation catalyst has low temperature activity.

Development of CO_2 selective separation membranes and its application processes

Mechanism of CO_2 separation membrane

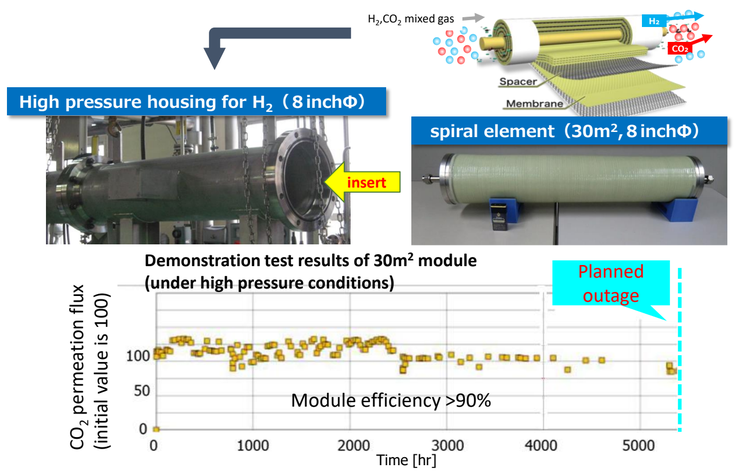
Schematic of facilitated transport membrane using selective reversible reaction between CO_2 and carrier



The heat generated at the feed side of the membrane is effectively used for the desorption of CO_2 at the permeate side.

High selectivity. No energy consumption.

Development of CO_2 separation membrane module

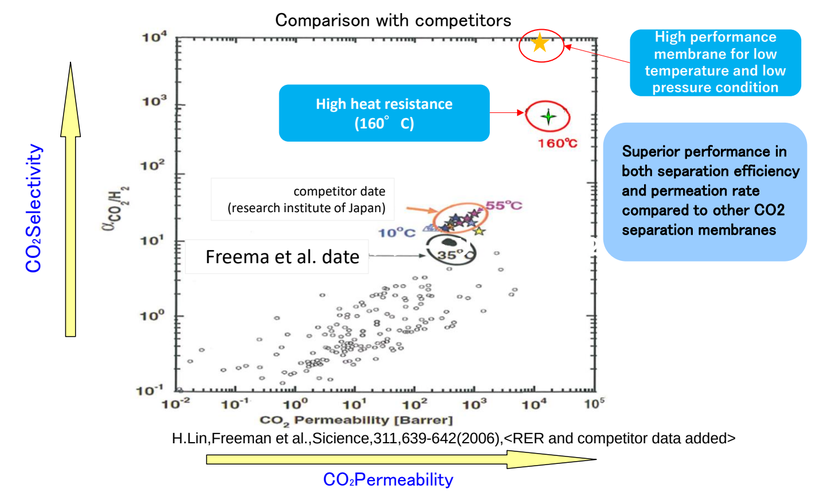


Establish long-term durability with 30m² spiral module



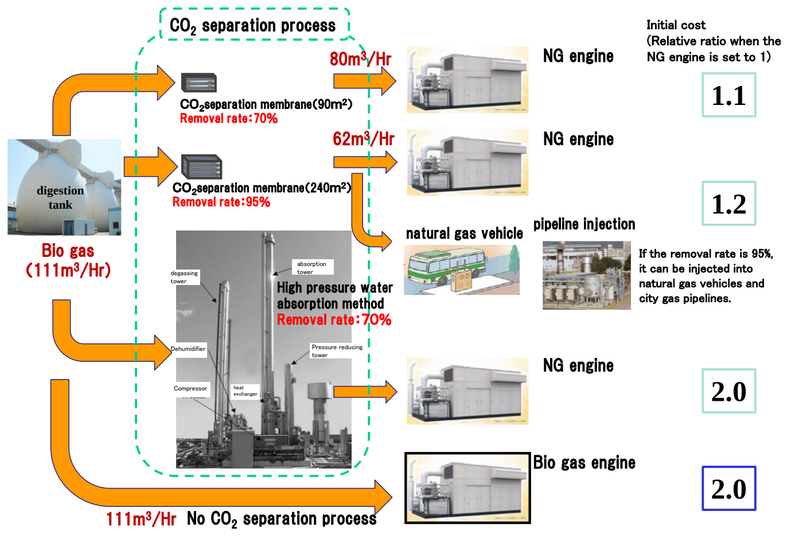
CO_2 separation unit with 15 membrane modules

Superiority of RER CO_2 Separation Membrane

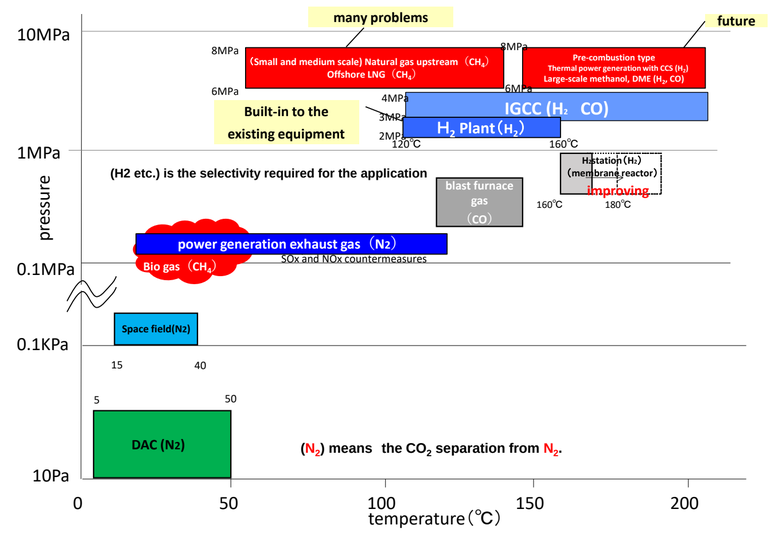


World-class performance as a CO_2 separation membrane

Cost reduction by applying CO_2 separation membrane to biogas



Target MAP (Temperature-Pressure) of CO_2 separation process



Company Profile

Dr. Osamu Okada worked at Osaka Gas Co.,Ltd from 1977 to 2004. He developed catalysts, and did a lot of inventions of catalysts for city gas production and hydrogen production. He was executive researcher and general manager of the Advanced Reforming System Project in 2003. He left Osaka Gas Co., Ltd, and founded RER in 2004.

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