

The exhaust gas from a power plant can be recovered and used as a raw reaction material

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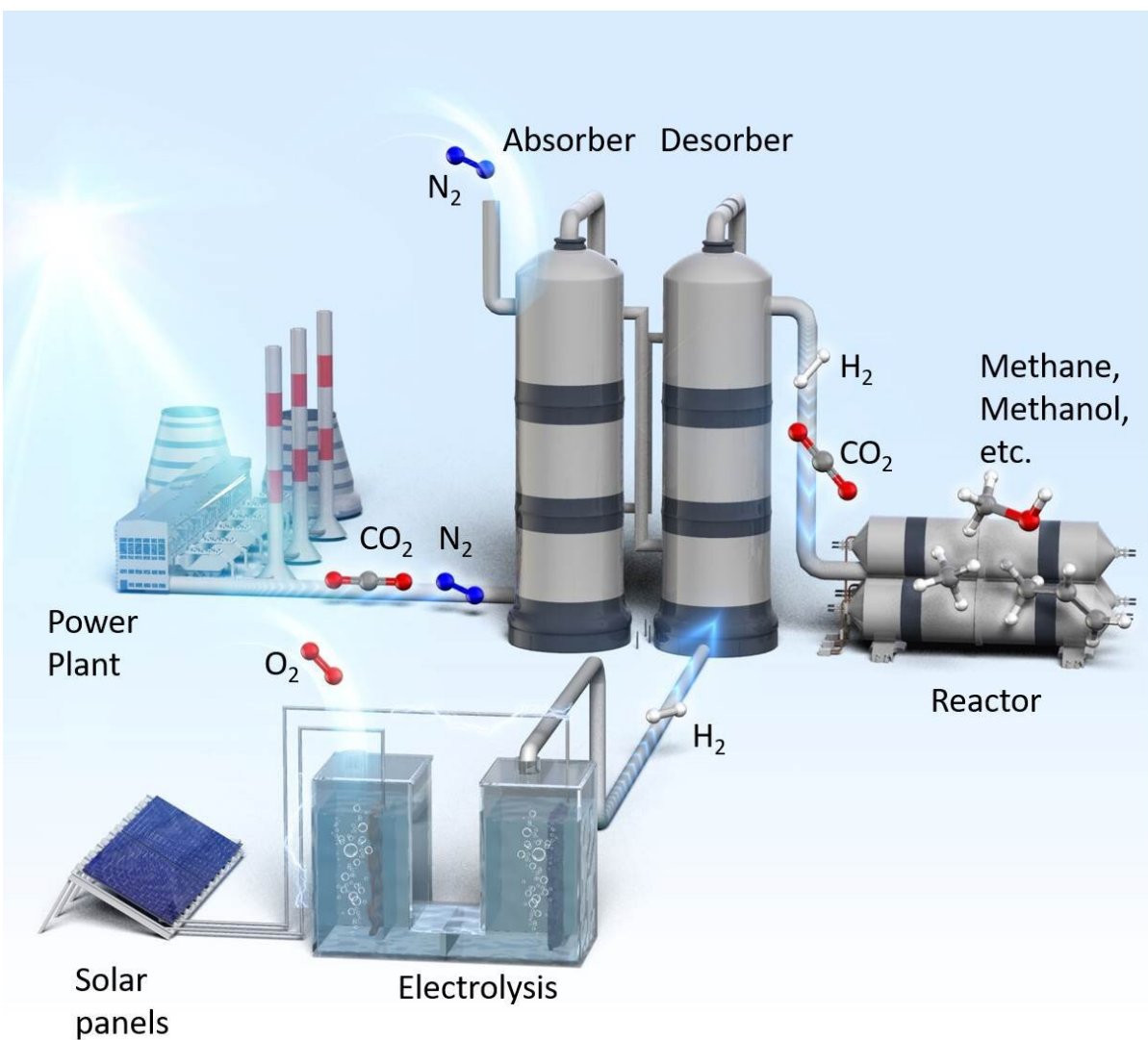


Fig. 1 Outline of process using “H₂ stripping regeneration technology” CO₂ partial pressure in the desorber is lowered by the H₂ supplied to the bottom of the desorber and the mass transfer of CO₂ from a liquid phase (i.e., amine solution absorbing CO₂) to a gas phase is accelerated, making the desorber temperature lower. The mixture of CO₂ and H₂ gases collected from the head of the desorber can be used as material for the CO₂ reduction reaction. As illustrated in the figure, the process to fabricate petroleum-independent fuel or chemicals is made feasible by making use of H₂ electrolyzed by renewables (e.g., solar energy) and CO₂ included in exhaust gas from facilities such as power plants. Credit: Nagoya University

A research group at Nagoya University has developed a new technology that can drastically conserve the energy used to capture carbon dioxide (CO₂), one of the greenhouse gases, from facilities such as thermal power plants. Conventionally, a significant amount of energy (3 to 4 GJ/ton-CO₂) or high temperatures exceeding 100 deg.C has been required to capture CO₂ from gases exhausted from a concentrated source, and there are expectations of the development of CO₂ capture technology that consumes less energy.

The research group led by Assistant Professor Hiroshi Machida has developed an unprecedented CO₂ capture technology, namely H₂ stripping regeneration technology¹), in which hydrogen (H₂) gas is supplied to the regeneration tower (desorber)²). It is indicated in this research that, with the implementation of this new technology, combustion exhaust gas can be replaced by CO₂/H₂ gas at [lower temperatures](#) (85 deg.C) than those used in conventional technology. The further reduction of [energy](#) can be achieved when it is combined with technologies such as those involved in the promotion of exhaust heat utilization and recovery of reaction heat.

This new technology can exhibit the world's highest energy-saving

performance (i.e., separation and collection of energy required is less than 1 GJ/ton-CO₂ when a desorber temperature is 60 deg.C) when it is combined with the phase-separation solvent that this research group has also developed.

This technology is expected to be applicable to value-added material production such as the syntheses of methane, methanol, gasoline, etc., from CO₂ in the combustion exhaust gas and H₂ from [renewable energy](#), and is expected to contribute to carbon recycling.

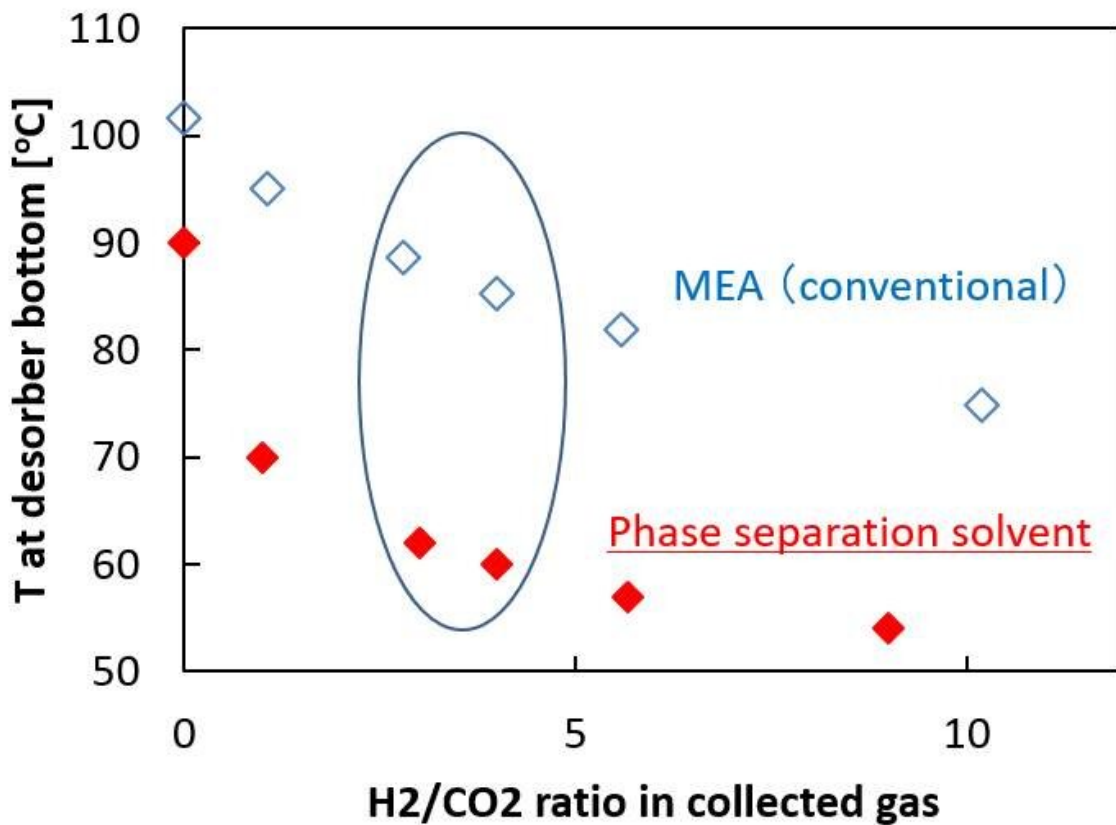


Fig 2. Comparison of H₂/CO₂ ratio in collected gas and temperature reduction in desorber As the H₂/CO₂ ratio increases, the temperature at the bottom of desorber will decrease. Stoichiometrically, the ideal H₂/CO₂ ratio is 4 for the

methane synthesis process and 3 for the methanol synthesis process (See area within ellipse in the figure). The phase-separation solvent is characterized by a low regeneration temperature, and the H₂ stripping regeneration process can further lower the regeneration temperature. Credit: Nagoya University

(1) H₂ stripping regeneration technology

In the conventional process to synthesize fuel or chemicals from CO₂ and renewable H₂, pure CO₂ is collected and is then mixed with H₂ before being supplied to the reduction reactor. In the H₂ stripping regeneration technology, H₂ gas is supplied at the bottom of the desorber. As a result, CO₂ partial pressure in the desorber is lowered, which promotes regeneration and lowers the regeneration temperature. The mixture of CO₂ and H₂ gases collected from the head of the desorber is supplied directly to the synthesis reactor.

(2) Regeneration tower (Desorber)

In the amine absorption method, CO₂ absorption and [regeneration](#) towers (i.e., absorber and desorber) are used to separate and collect CO₂ in the exhaust gas mixture from facilities like power plants. Gases such as N₂ and O₂, in addition to CO₂, are included in the combustion exhaust gas from these facilities and pure CO₂ gas is collected with this amine absorption method. Only the CO₂ gas is absorbed in the absorber by amine solution, and it is then heated in the desorber to regenerate pure CO₂ gas. In other words, only CO₂ gas can be extracted from the mixture of gases.

More information: Hiroshi Machida et al. Energy-Saving CO₂ Capture by H₂ Gas Stripping for Integrating CO₂ Separation and Conversion Processes, *ACS Sustainable Chemistry & Engineering* (2020).

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