Kato Laboratory

Thermal Energy Storage and Utilization Technologies for Low-Carbon Society

Laboratory for Zero-Carbon Energy, Institute of Innovative Research
http://www.zc.iir.titech.ac.jp/~yukitaka

Carbon dioxide emission mitigation is important for global environment protection and fossil fuel consumption saving. Thermal energy storage and utilization technologies are effective for the mitigation. For utilization of nuclear and renewable energies, energy storage and conversion technologies are being developing.

Thermochemical Energy Storage (TcES)

Exothermic

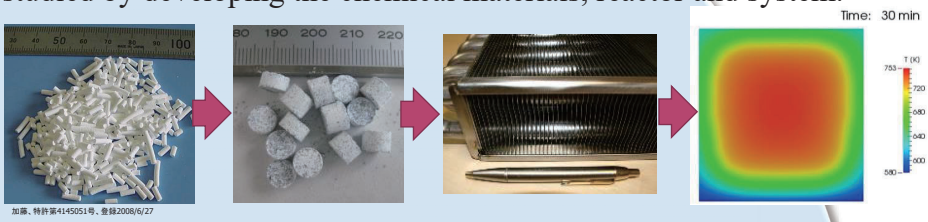
$$MgO + H_2O \rightleftarrows Mg(OH)_2$$

Endothermic

Through exothermic reaction;
Chemical energy → Heat energy

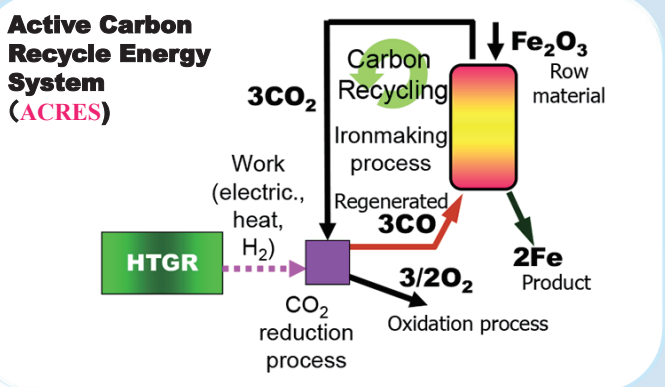
Through endothermic reaction;
Heat energy → Chemical energy

Thermochemical energy storage (TcES) which use chemical reactions for heat management are being developed for heat recovery, storage and transformation of surplus heats emitted from nuclear and renewable energy systems, industrial processes and engines. Magnesium oxide/water and other chemical heat pumps are being studied by developing the chemical materials, reactor and system.



Development from TcES material to system

Active Carbon Recycling Energy System



Active Carbon Recycling Energy System (ACRES) in which emitted carbon dioxide is recovered and regenerated into carbon material by using a high-temperature gas reactor (HTGR) and renewable energies has been proposed. Smart ironmaking system based on ACRES (iACRES) is being developed. ACRES is expected to contribute on the saving of carbon resource consumption and the mitigation of carbon dioxide emission.

High-Efficient Hydrogen Production System

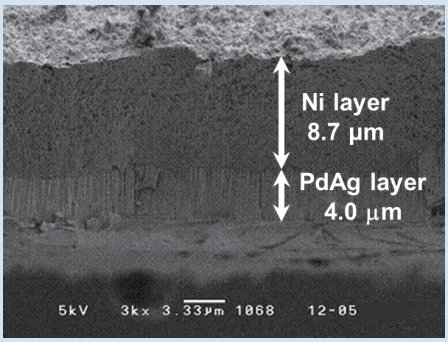


Fig. Developed hydrogen permeation membrane prepared by the reverse build-up method

A plate-type fuel reformer for high-efficient hydrogen production using nuclear and renewable energies is developed. Hydrogen permeation membrane is the key material for the reformer. New original membrane which uses 1/10 of Palladium alloy for conventional membrane is being developed by the reverse build-up method.