Energy Storage

R&D Project Title : Development of Heat Storage Oxide Materials Utilizing Environmental Moisture

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Summary :

We aim to improve the heat-storage energy density and extend the heat-charge temperature range of layered manganese dioxide, which is an environmentally friendly heat storage material using the endothermic and exothermic phenomena associated with the (de-)intercalation of water molecules in the atmosphere. Layered manganese dioxide, which encapsulates potassium ions in the interlayer, exhibits a fast reaction rate, excellent heat storage and release cycles, a relatively high thermal energy density (>1,000 MJ/m^3), and a heat storage temperature (100-140°C) suitable for recycling low-temperature waste heat. We will improve the heat-storage energy density and control the hydrate-dehydrate transition temperature (heat charge temperature) by optimizing the crystallite size and the type and concentration of interlayer ions. The challenge is to maximize the excellent water absorption and desorption properties of the bulk material for practical use. With this heat storage technology, the low-grade waste heat (100-200°C), accounting for more than 60% of unused waste heat, can be recovered and reused as an auxiliary heating source in the manufacturing industry. If all unused exhaust gas emitted in Japan were stored and assuming a heat storage/release efficiency of 73%, it is expected to reduce carbon dioxide emissions by 47.35 million tons per year.

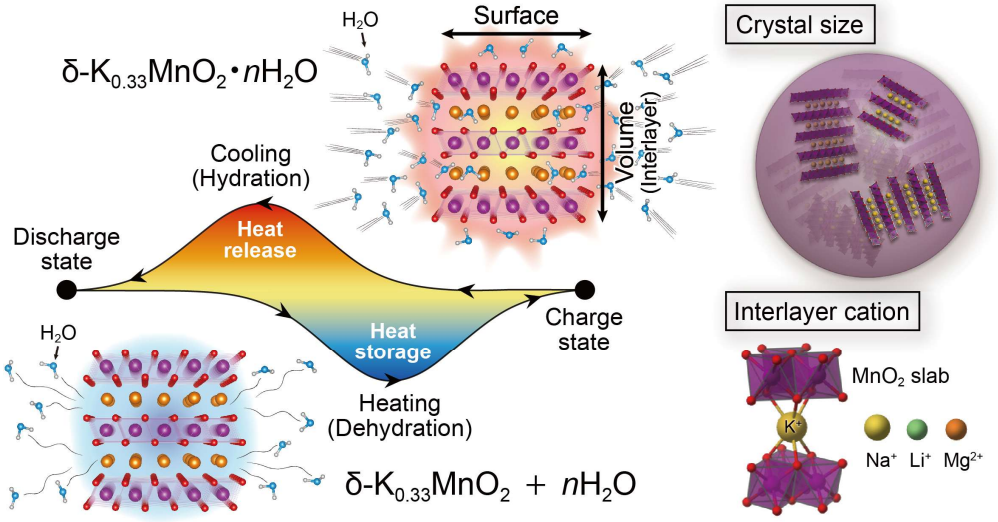

Figure. Design guidelines for the application of layered manganese dioxide as a heat storage material utilizing exo/endothermic reactions by absorption/desorption of the environmental moisture.