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宇宙惑星居住実現に向けた熱エネルギー貯蔵

Thermal Energy Storage for Realization of Space Planet Residence

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So-called the use of renewable energy, such as solar or solar thermal power generation could be one of the fundamental infrastructures for space plant society without fossil fuels. These power generation systems have also attractive because they can produce energy semi-permanently. However, these systems have a critical disadvantage in that the electric power supply is intermittent. In the case of the lunar residence, half of the month, people need to live without an energy power supply. Therefore, energy storage is essential to deal with the intermittency of the power supply in the space plant residence.

Not only the importance of the energy storage for the space planet resident but also energy storage is positioned as a strategic and integrant part for stabilizing the renewable energy supply. Electric thermal energy storage facilities (**Fig. 1**) have been proposed for the stabilization technology[1,2]. In this facility, electricity is converted to heat, and the energy is preserved as thermal energy in a storage system. The electricity can be produced from the stored thermal energy using a thermal cycle according to the need.

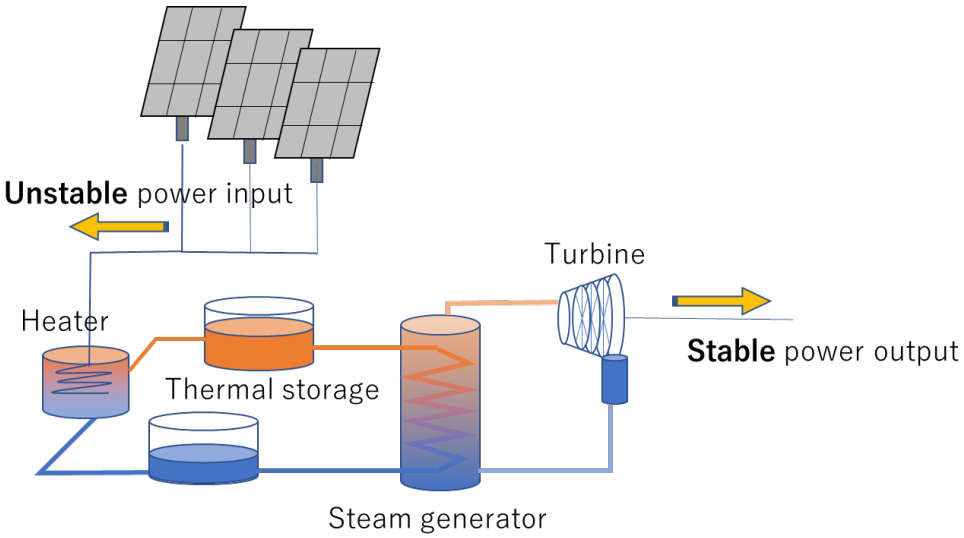

Fig. 1. An example of a simplified configuration of the electric thermal energy storage facility.

The thermal energy can be stored using sensible heat, or latent heat of materials such as metal[3], and salt[4], or heat of reaction[5]. The materials used for the thermal energy storage materials such as silicon, aluminum, and iron are obtainable even in the lunar environment due to their higher elemental abundance in the regolith. Therefore, this energy storage facility for the space plant resident could be constructed in situ resource utilization through the material processing

technique such as electrochemical processing at high temperatures. The coupling of the electrochemical processing with the thermal energy storage could be also deeply relating to the global sustainability and realization of a low carbon society.

To develop the refining, and casting processes needed for manufacturing these thermal energy storage materials in a space plant environment, numerical simulation or material processing under reduced gravity conditions are required. The thermophysical properties of the molten state of the metal and salt at high temperatures are indispensable for the process simulation. The measurement of the thermophysical properties of the molten metal and salt can be achieved using levitation techniques such as electromagnetic levitator [5,6], gas jet levitator [7], and electrostatic levitator [8], which have remarkably developed in the last two decades.

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