
SESSION 8: Magnetic Refrigeration

Paper 8.2 Wednesday POSTER Session 1:15 to 2:45 PM

Study of Method for Reducing Actuator Load in Active Magnetic Regenerative Refrigeration (AMR)

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The Active Magnetic Regenerative Refrigerator (AMR) we have developed is aimed at liquefying hydrogen. AMR generates cooling capacity by incorporating the magnetocaloric effect into the AMR cooling cycle. The magnetocaloric effect is a phenomenon in which application/removal of a magnetic field to a magnetic material causes an exothermic/endothermic reaction. The magnetic field applied to the magnetic material is controlled by moving the magnetic material in and out of the superconducting coil. Depending on the magnetization of the magnetic material and the magnitude of the magnetic field, a magnetic attraction force is induced between the magnetic material and the superconducting coil, which loads the actuator that moves the magnetic material. We considered that one way to increase the cooling efficiency of AMRs can be to reduce power consumption of the actuator by reducing the load on the actuator. In our AMR, two magnetic material containers are arranged in series, and when one enters the magnet during operation, the other exits the magnet. The load on the actuator that moves the magnetic material containers is the combined force of the magnetic attraction force determined by the position of the magnetic material relative to the superconducting coil, the gravity of the magnetic material and structure, and the frictional force of the actuator shaft. To reduce the maximum value of this combined force, we considered installing a specific spring mechanism along the actuator shaft. This spring mechanism allows the spring to store elastic energy when the magnetic materials stop and to use the stored energy when the magnetic materials start to move. The presentation will discuss what kind of spring mechanism should be installed and the calculated reduction in actuator load and power consumption due to the installation of a spring mechanism.