SESSION 3: Brayton, J-T and Sorption Cryocoolers
Paper No. 3-1 Tuesday Afternoon 1:45 PM

Development of Sorption Compressor with Miniaturized Check Valves

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A sorption J-T cooler can be utilized to cool sensitive sensors of space observatory missions since it is operated with "vibration-free" sorption compressor, which utilizes adsorption characteristic of adsorbent such as activated charcoal. The activated charcoal which fills the compressor cell can adsorb and desorb the helium according to its temperature. The pressure swings in the cell are thermally generated without any mechanical vibration. The compressor cell developed in this paper has a thin-plate shape to reduce the heating and cooling time so that the pressure swing can be accelerated. Its width, height and the thickness are 100 mm, 100 mm and 4.6 mm, respectively. In the cell, the cubic pillars with one side length of 1 mm, are arranged to reinforce the structural rigidity and thermal diffusion into the activated charcoal. For heating the cell, a polyimide film heater is attached to the top surface of the cell. For cooling the cell, the cold head of commercial G-M(Gifford-McMahon) cryocooler is thermally connected to the cell via copper thermal link. Two identical cells are operated alternately to build a continuous pressure gradient for the J-T cooler. In addition, the passive check valve is developed to continuously provide sufficient pressure from the compressor to the J-T expansion part, rectifying the mass flow from the cells. When the flow direction is reversed in the valve, the leakage is passively prevented by contacting two metal surfaces at low temperature (20 K). The essential parts of the valve are critically miniaturized and welded to minimize the overall thermal inertia of the system. The mass flow rate from the compressor and its efficiency are measured for performance comparison with other thermal compressors. Consequently, the strategy to increase the mass flow rate and the efficiency of the compressor are discussed.