
SESSION 2: JT & Sorption Coolers

Paper 2.2

Tuesday ORAL Session

11:00 AM

Development of 5 K Sorption J-T Cooler with Thin-Plate Type Sorption Compressor

***J. Bae, D. Kwon, S. Jeong, Korea Adv. Inst. of Science and Tech.
(KAIST), Daejeon, Korea***

With the aim of providing vibration-free cooling for infrared sensors, a miniaturized sorption J-T(Joule-Thomson) cooler is developed to achieve 5 K cooling. The J-T cooler features a thin-plate type sorption compressor and a recuperative heat exchanger with low thermal inertia. The sorption compressor comprises two thin-plate type sorption cells filled with activated charcoal to adsorb helium, and passive check valves that prevent the reverse flow with metal-to-metal contact seal. By adopting the thin-plate shape for the compressor cell, its pressure building capacity can be significantly increased by reducing the temperature gradient within it. Furthermore, it can operate without a heat switch since the heating power can be applied to the cell impulsively, minimizing heat leakage to the heat sink. Its width, height and the thickness are 100 mm, 100 mm and 4.6 mm, respectively. The nominal mass flow rate of the thin-plate type sorption compressor is 0.77 mg/s, with nominal high and low pressures of 1141 kPa and 165 kPa, respectively. The heat exchanger of the J-T cooling part is tube-in-tube type with a coiled inner tube, designed and manufactured to achieve the target temperature of 5 K without a bypass valve. The high-pressure stream is pre-cooled to the temperature between 11 K and 20 K by a G-M(Gifford-McMahon) cooler before entering the heat exchanger. Subsequently, open-loop and closed-loop tests are performed to demonstrate the cooling temperature of 5 K. Furthermore, the COP of the overall system is analyzed according to the operation parameters and the effectiveness of the heat exchanger. Consequently, the strategy to increase the efficiency of the sorption J-T cooler is discussed.