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A hybrid 3He Joule-Thomson cryocooler using a spiral flow channel evaporator for space applications

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The 3He Joule-Thomson (JT) cryocooler utilizes the JT effect of 3He to typically achieve the temperature of below 2 K. When the 3He JT cryocooler obtains the temperature of below 2 K, the working fluid at the JT impedance must be in a choked state, which means the Mach number of working fluid at the JT impedance is 1. The working fluid behind the JT impedance at this situation is two-phase fluids. In addition, the pressure of the working fluid behind the JT impedance is usually below 20 kPa. Thus, it is crucial for the hybrid 3He JT cryocooler to efficiently extract the cooling capacity from the low-pressure high-speed two-phase flow. Considering that there is no gravity at space, a new evaporator using the centrifugal force with spiral flow channels is designed, manufactured, and applied in the hybrid 3He JT cryocooler.

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