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Study on a miniature mixed-gases Joule-Thomson cooler driven by an oil-lubricated mini-compressor for 120 K temperature ranges

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The mixed-gases Joule-Thomson (J-T) refrigerator driven by oil-lubricated compressor has many merits, such as high reliability, low cost, high efficiency with optimized design. For many applications, the size and weight are crucial factors for the system design. Miniature J-T coolers, especially those open cycle coolers using high-pressure pure nitrogen for infrared devices cooling, have already been used for decades, in which the size of the cold figure is quite small with Linde-Hampson heat exchanger. With the progress of miniaturization technologies, oil-lubricated mini-compressors are available for individual cooling or electronic devices applications.

So in this paper, a miniature J-T cooler using multicomponent mixtures was developed and tested, in which an oil-lubricated mini-compressor was used to drive the cooler. A plate-fin type heat exchanger with micro-channel configuration was designed and fabricated with electric wire-cutting method, which is used as the recuperative heat exchanger. Experimental tests on the performance of the miniature J-T cooler were carried out. The minimum no-load temperature of 110 K and about 4 W cooling capacities at 118 K were achieved. Such miniature J-T coolers driven by oil-lubricated mini-compressors show good prospects in many applications.

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