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A kW-class Free-Piston Stirling Cooling Prototype for Ultra-Low Temperature Freezing

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In recent years, the demand for ultra-low temperature freezer has been growing rapidly. It can not only be used for some special food deep freezing, but also be popularly utilized in biological storage. There are some conventional cooling technologies such as Freon-based two-stage cascade and single-stage mix-gases J-T refrigeration system. However, because of having better performance potential in environmental-friendliness and energy efficiency, the free-piston Stirling cooler is getting attention for the development for ultra-low temperature freezing. In this paper, we designed and built a kW-class free-piston Stirling cooling system for ultra-low temperature freezing, which can operate in temperature range from -100℃ to -60℃. Our experimental results show that the system can obtain a cooling capacity of nearly 1000W@-80℃ with a corresponding COP around 0.5 under a charging pressure of 3MPa, a working frequency of 50Hz and an input pressure ratio of 1.3. As a result, it demonstrated that the free-piston Stirling cooling system has good potential of achieving high efficiency and large cooling capacity for the ultra-low temperature freezing application.