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A 4 K Gas-Coupled Two-Stage High-Frequency Pulse Tube Cryocooler

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The high-frequency pulse tube cryocoolers (HPTCs) feature high energy flow density, low vibration, good stability and reliability. Here we report a gas-coupled two-stage HPTC, which adopts a coaxial structural arrangement, is driven by only one compressor, and has an extremely compact structure. The cryogenic double-inlet, cold inertance tube and cold gas reservoir are adopted as the phase shifter for the second stage. Moreover, the multi-bypass structure is also applied in the second stage to further enhance cooling performance. Under the condition of a 2.25 MPa charging pressure and a 25 Hz operating frequency, the experimental prototype obtains a no-load temperature of 4.3 K, and provides a cooling power of 50 mW at 6.5 K with a 425 W input electric power. This paper also introduces the structure of the prototype and its cooling performance under different operating conditions, including charging pressure, frequency and input power.