

Performance of a precooled 4 K Stirling type high frequency pulse tube cryocooler with GOS

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Key words: Stirling type pulse tube cryocooler, 4 K, Regenerator material, Regenerator Loss, High frequency, Precool, Cold inertance tube

Key methodology

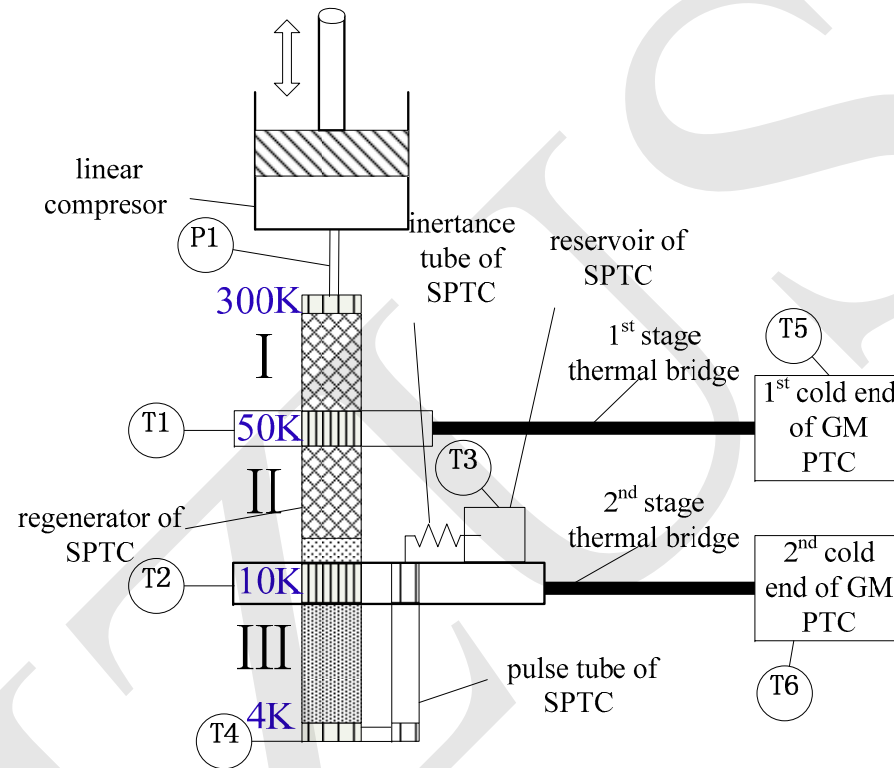
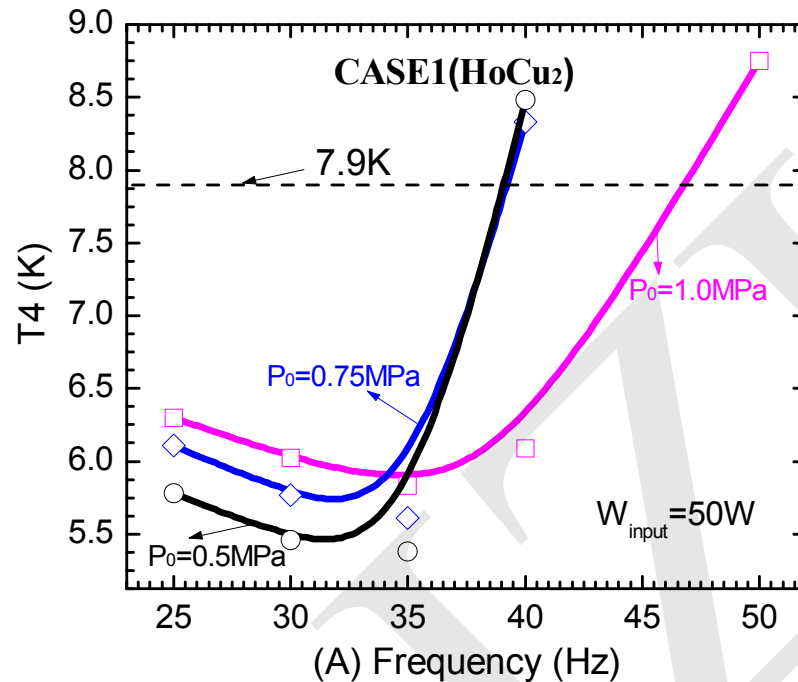


Fig. 4 Schematic of single-stage SPTC with precooling

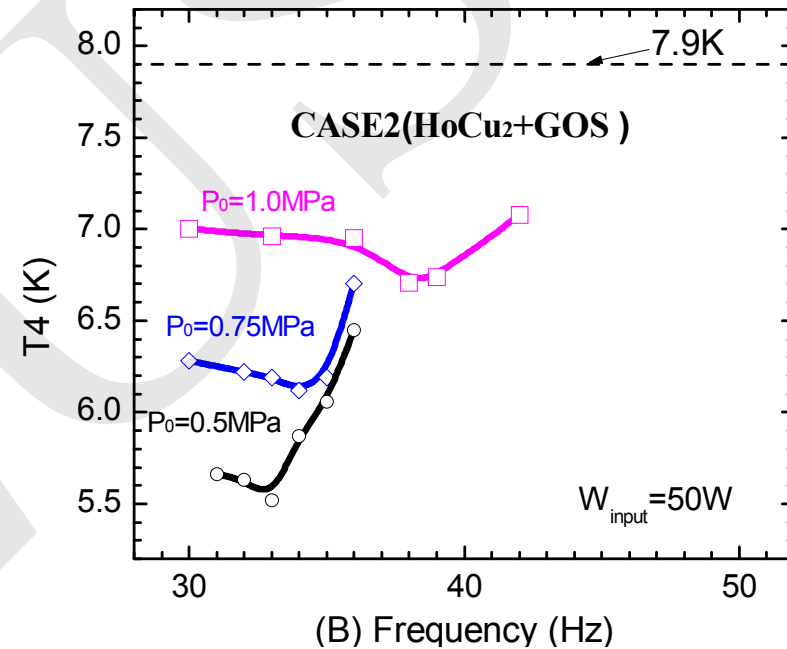
A 4K single-stage Stirling type high frequency pulse tube cryocooler (SPTC) pre-cooled by a two-stage G-M type pulse tube cryocooler (GMPTC) was developed to simulate a three-stage SPTC. The precooling power at the first and second cold end of the GMPTC was obtained. A ceramic magnetic regenerative material GOS was used to enhance heat transfer at 4K.

No-load Refrigeration Temperature

■ Low-temperature Regenerator performance is severely sensitive to frequency at lower average pressures.



(a) HoCu₂



(b) HoCu₂+GOS

Fig. 10 Effect of operating frequency on Refrigeration temperature for CASE1 (a) and CASE2 (b)

Second Precooling Power

- Lower average pressure leads to lower second precooling power. The case with HoCu₂ yields better performance for regenerators at low temperatures.

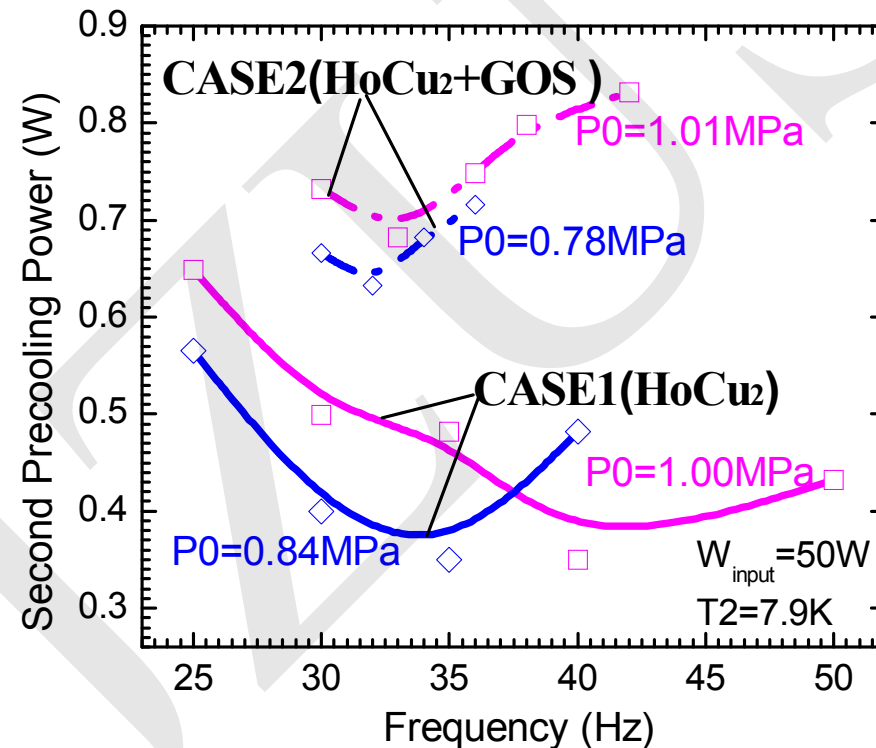


Fig. 11 Effect of operating frequency on second precooling power

No-load Refrigeration Temperature

- Both first precooling temperature and first precooling power is almost independent of frequency and average pressures.

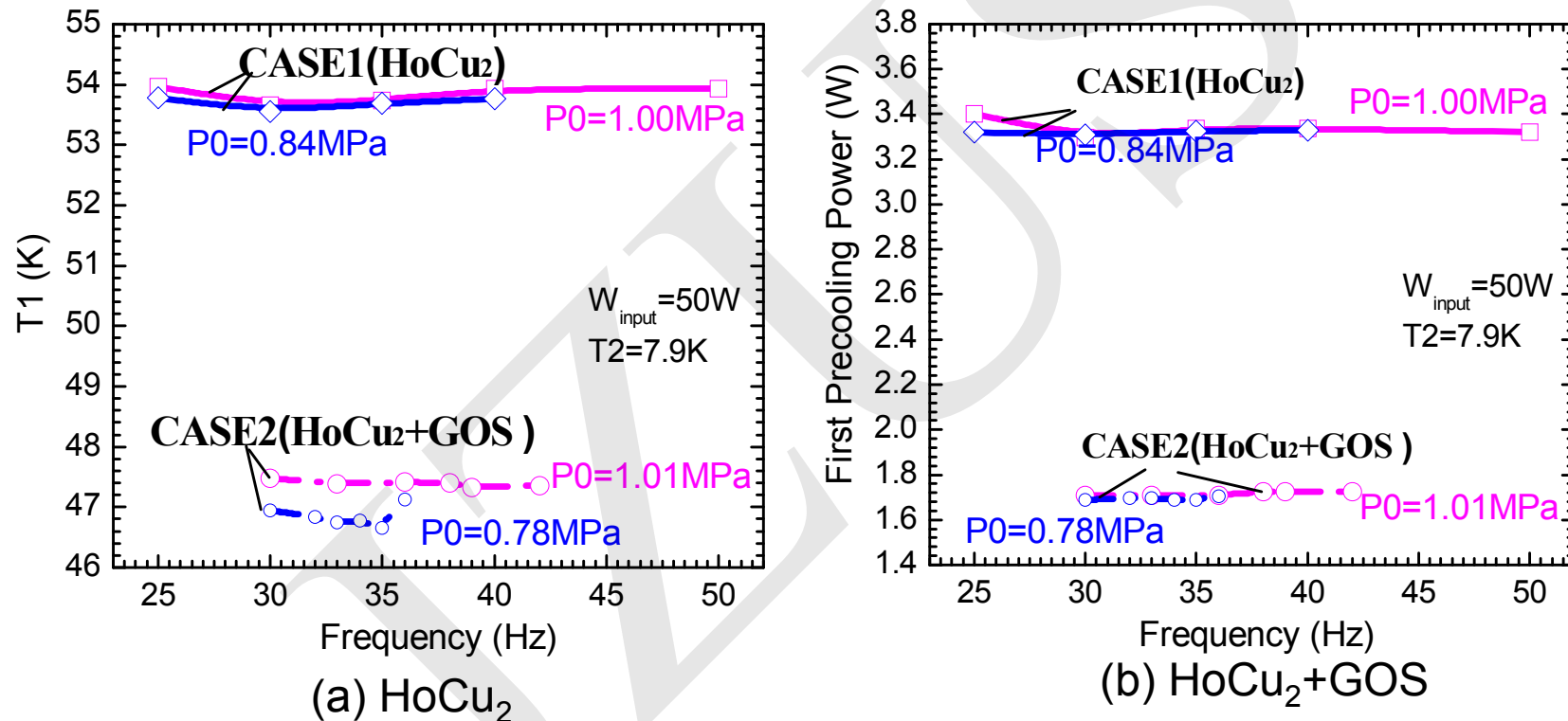


Fig. 12 Effect of operating frequency on first precooling temperature and first precooling power

Conclusions

- Lower average pressure yields lower refrigeration temperature and second precooling power.
- Performance of the final stage regenerator is strongly sensitive to operating frequencies especially at low average.
- Behavior of regenerators working at warmer stages is almost independent of frequencies and average pressures.
- Regenerator material porosity in the final stage has significant effect on the first precooling power in that it severely influences the phase shift between mass flow and pressure in the regenerator.
- The precooling power of the first stage is reduced remarkably in the case with GOS filling.