



Temperature inhomogeneity in high capacity pulse tube cryocoolers

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What is temperature inhomogeneity?





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Temperature inhomogeneity

Typical characteristics

- 1. The temperature difference (ΔT) observed around regenerators.
- 2. occurs in a small length/diameter ratio regenerator or in some regenerators connected in parallel.
- 3. high thermal conductivity screens could suppress temperature inhomogeneity effectively
- 4. DC flow in the regenerator.

Generation mechanism





Driving mechanism





Suppressing methods







Difficulties and Prospect



Difficulties

- Simulation
- measurement

There are two points to make about current difficulties in theoretical research, simulation, and experiment:

- Accurate 3D model for flow and heat transfer in a porous volume is hard to build up,
- Both gas and screen temperatures in regenerators are hard to measure.

Prospect

- Computational fluid dynamics
- Visualization

Future development for temperature inhomogeneity study will move towards 3D simulation and experimental measurements. For theoretical study, the generation process of inhomogeneity will possibly be reproduced in 3D models by the CFD method, which is expected to explain the generation and driving mechanism reasonably well. Then the temperature contour could be displayed by frost line on the shell of the regenerator, or other methods, such as the particle image velocimetry method and infrared observation to visualize temperature inhomogeneity.