BRIEFING CHART

NASA SBIR/STTR Technologies

Micromachined Active Magnetic Regenerator for Low Temperature Magnetic Coolers

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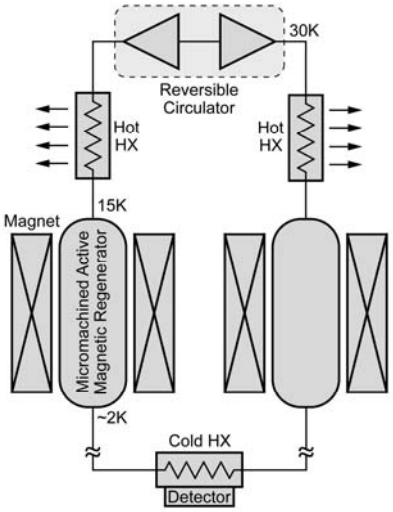
Identification and Significance of Innovation

- A lightweight, reliable, efficient Active Magnetic Regenerative Refrigeration (AMRR) system for space applications
  - Cooling temperatures in the range of 2 K
  - Heat sink temperatures higher than 15 K
  - Ability to provide remote/distributed cooling
  - Much simpler and lighter than a multistage ADR
- Propose to develop an innovative Micromachined Active Magnetic Regenerator (MAMR)
  - Enable efficient operation of the AMRR
  - Increase AMRR heat sink temperature
- Innovative microfabrication technologies and flow configuration in an MAMR to achieve
  - Uniform flow distribution
  - High convective heat transfer
  - Low axial condition heat leak

Expected TRL Range at the end of Phase II Contract: 4–5



System Schematic of an AMRR

- The reversible cryogenic circulator is being developed under an ongoing NASA SBIR project. Critical technical milestones have been reached.
- Here we propose to design and build the highly effective MAMR
- In Phase III we will build a complete AMRR

Technical Objectives

- Prove the micro-fabrication approach
- Prove the thermal performance of the MAMR
- Show the performance benefits of MAMRs for an advanced AMRR

Work Plan

- Phase I
  - Develop microfabrication technology for high-aspect-ratio microchannels in magnetic refrigerant wafers
  - Demonstrate thermal and flow performance by detailed numerical analysis
  - Produce an optimal MAMR design and its predicted performance data
- Phase II
  - Build and demonstrate a prototype micromachined active magnetic regenerator

NASA Applications

- Cooling systems for cryogenic detectors for sensing X-ray, infrared, and sub-millimeter radiation (bolometers and microcalorimeters)
- International X-ray Observatory (IXO) and Single Aperture Far-Infrared Observatory (SAFIR)

Non-NASA Applications

- Cooling systems for:
  - Material microanalysis
  - Cryogenic particle detectors
  - Biomolecule mass spectrometry
- Coolers for hydrogen liquefaction

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