National Aeronautics and Space Administration

Smart Thermal Control System for Power-Efficient Electronics in Extreme Cold Environment Missions

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Program: FY22 R&TD Topics
Strategic Focus Area: Thermal control systems

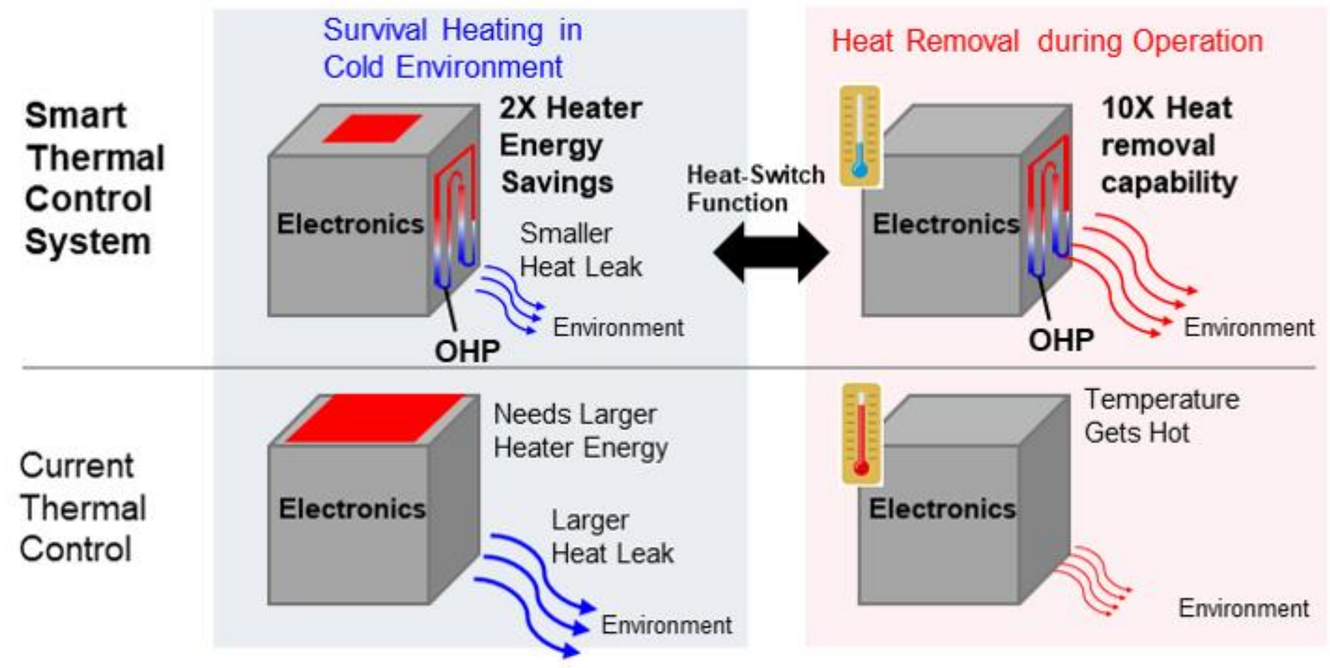

Fig. 1 Concept of Smart Thermal Control System

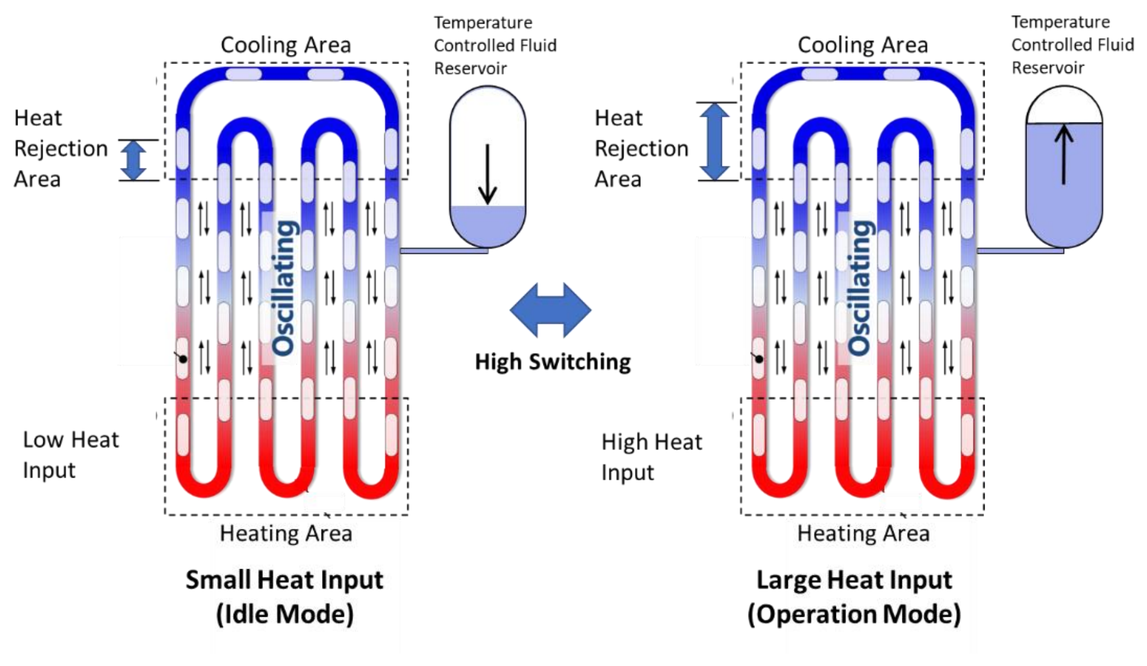

Fig. 2 Smart Switching Oscillating Heat Pipe (SSOHP)

Objectives:

The objective of this task is to develop a highly energy efficient thermal management system for electronics in Ocean Worlds' missions. Specific objectives are to develop an Additively Manufactured (AM) electronics chassis with an embedded Smart Switching Oscillating Heat Pipe (SSOHP) that can transport 200 W with an effective thermal conductivity 5,000 W/m-K and can shut-off heat transport with a heat switch on/off ratio of 500 (ON; 10W/K, OFF; 0.02W/K). This embedded thermal system will enable heat spreading within the electronics chassis to share heat from hot components to cold components and also provide a thermal switch to the environment to reduce heat leaks during idle periods. If the technology is successfully developed, that realizes 2 times of energy saving comparing to the current electronics design, and also 10 times higher heat removal capability in operational phase while additional mass is kept minimum.

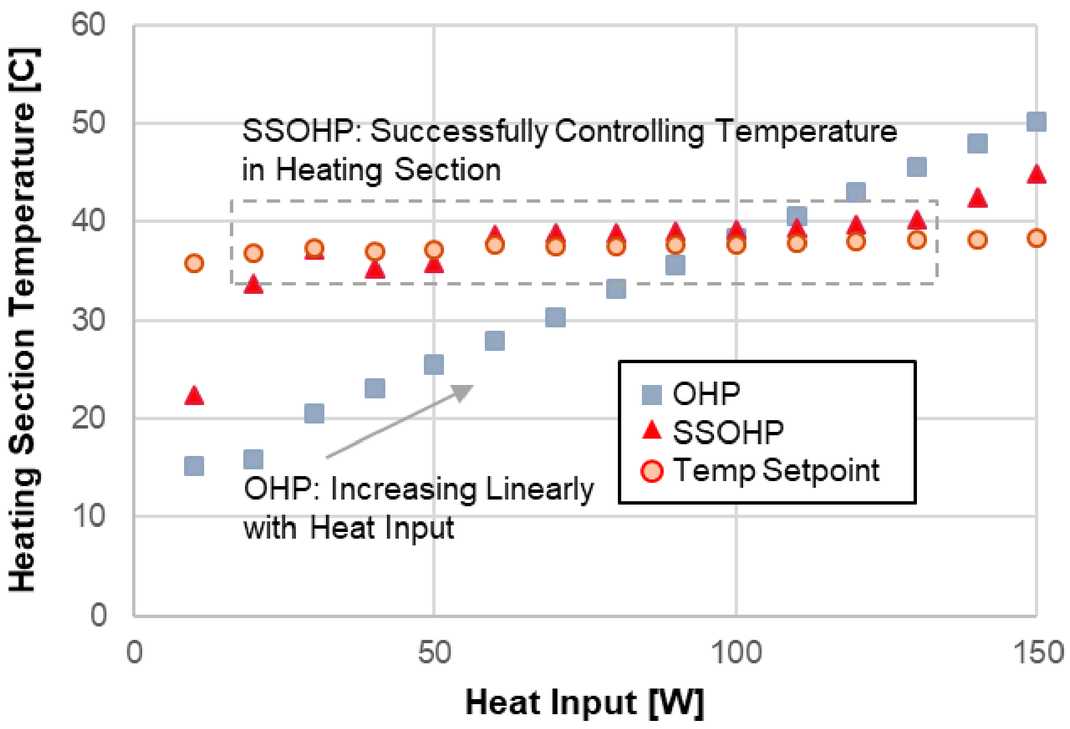

Fig. 5 Temperature Controllable Function of SSOHP

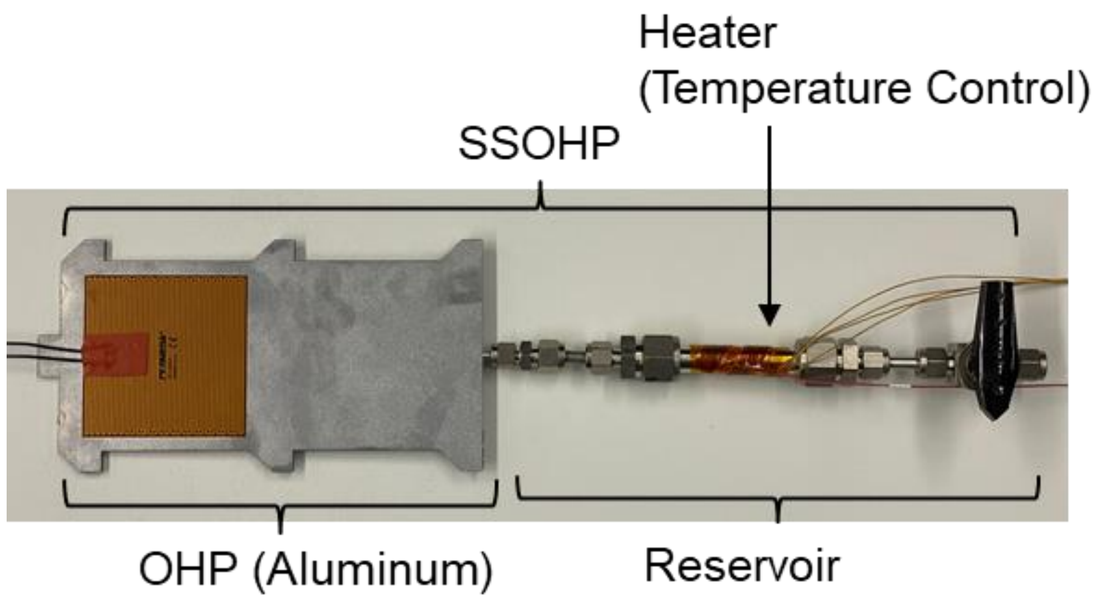

Fig. 3 SSOHP Prototype

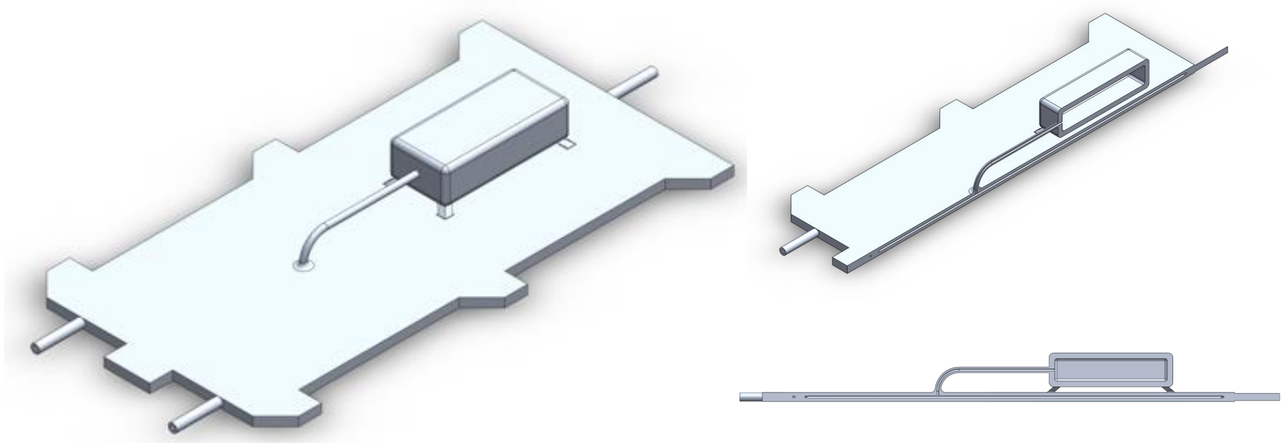

Fig. 4 SSOHP Design for Additive Manufacturing

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