Apr 30th, 8:00 AM

Paper Session II-C - A Shape Memory Alloy Based Cryogenic Thermal Conduction Switch: Design, Construction and Materials Development

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Session 2: Spaceport Research & Development and Future Missions
2C - University Research for Future Spaceport Applications

A Shape Memory Alloy Based Cryogenic Thermal Conduction Switch: Design, Construction and Materials Development

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Shape memory alloys (SMAs) can produce large strains when deformed (e.g., up to 8%). Heating results in a phase transformation and associated recovery of all the accumulated strain. This strain recovery can occur against large forces, resulting in their use as actuators. Thus an SMA element can integrate both sensory and actuation functions, by inherently sensing a change in temperature and actuating by undergoing a shape change as a result of a temperature-induced phase transformation. Two aspects of our work on cyrogenic SMAs are addressed. First - the design, construction and testing of a shape memory alloy based cryogenic thermal conduction switch for operation between dewars of liquid methane and liquid oxygen in a common bulkhead arrangement is presented. Such a switch integrates the sensor element and the actuator element and can be used to create a variable thermal sink to other cryogenic tanks for liquefaction, densification, and zero boil off systems for advanced spaceport applications. Second - fabrication via arc-melting and subsequent materials testing of SMAs with cryogenic transformation temperatures for switches, seals and valves is presented.