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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advanced Materials and Structures for High Temperature Applications (4)

Author: Dr. Suraj Rawal
Lockheed Martin Space Systems Company, United States, suraj.p.rawal@lmco.com

HEAT PIPE COOLED LEADING EDGES

Abstract

Heat pipes provide a very efficient method for conducting large amounts of thermal energy from the hottest areas of wing and inlet-cowl leading edges to regions where the energy can be actively or passively dissipated. Redistribution of the thermal energy can drastically reduce peak temperature such that shape-stable metal structure can replace recessing ceramic components. This technology development effort has focused on metallic-structure containment of sodium and lithium working fluids. For example, niobium alloy modules were fabricated, each with six embedded heat pipes. Each module design provided double containment of Li working fluid. Each module was fully coated with an oxidation resistant silicide based coating. Two of the heat pipe modules were successfully tested in air, and operated at the design temperature over 1000C.

Laboratory testing has validated performance in flight-like thermal profiles and identified design and manufacturing challenges. Recently, these heat pipe modules were successfully tested in an arc jet facility in equivalent operational conditions for 60 minutes durations. During each test, the heat pipe modules exhibited reproducible performance with no dimensional changes or any other anomalies. In addition, a neutron diffraction based approach has been used to image the internal dynamics of the heat pipe working fluid. This presentation provides an overview of the development effort with specific observations and results of the arc jet testing of the Niobium/Lithium heat pipe modules.