

Orion EFT-1 Catalytic Tile Experiment Overview and Flight Measurements

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Abstract

This paper describes the design and results of a surface catalysis flight experiment flown on the Orion Multipurpose Crew Vehicle during Exploration Flight Test 1 (EFT1). Similar to previous Space Shuttle catalytic tile experiments, the present test consisted of a highly catalytic coating applied to an instrumented TPS tile. However, the present catalytic tile experiment contained significantly more instrumentation in order to better resolve the heating overshoot caused by the change in surface catalytic efficiency at the interface between two distinct materials. In addition to collecting data with unprecedented spatial resolution of the “overshoot” phenomenon, the experiment was also designed to prove if such a catalytic overshoot would be seen in turbulent flow in high enthalpy regimes. A detailed discussion of the results obtained during EFT1 is presented, as well as the challenges associated with data interpretation of this experiment. Results of material testing carried out in support of this flight experiment are also shown. Finally, an inverse heat conduction technique is employed to reconstruct the flight environments at locations upstream and along the catalytic coating. The data and analysis presented in this work will greatly contribute to our understanding of the catalytic “overshoot” phenomenon, and have a significant impact on the design of future spacecraft.