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CONDUCTIVE HEAT TRANSFER EFFECTS IN CU-INFUSED HYBRID ROCKET REGRESSION

Abstract

The Propulsion Research Laboratory (PRL) at Utah State University has recently developed a promising High-Performance "Green" Hybrid Propulsion (HPGHP) technology which consumes 3-D printed acrylonitrile butadiene styrene (ABS). It is well documented in technical literature that hybrid rocket systems generally have fuel regression rates that are typically 25-30This paper reports on an advanced extrusion and 3-D printing techniques; whereby, ABS-based fuels with varying levels of copper-metallization are manufactured. Hybrid-ABS fuel grains were printed from Cu-infused feed stock with 2The Cu-infused fuels are currently being tested at USU's Propulsion Research laboratory using a legacy 12-N hybrid thruster system. This legacy thruster system was previously designed for small spacecraft applications. During each static fire test, key characteristics including thrust, chamber pressure, oxidizer mass flow, and beginning and ending fuel rates are observed. Fabrication and manufacturing methods are described, and results of hot fire tests are presented. A comparison of the calculated heat transfer models through the different fuel grain walls is discussed. The top-level conclusion is that Cu-infusion of the printed fuels measurably increases the fuel regression rate, allowing for a higher thrust level with no increase in the required volume. The Cu-infusion has negligible impact on the propellant characteristic velocity and the overall system specific impulse. The increased burn rate and overall increase in solid-fuel density resulting from Cu-infusion allows a measurable increase in the propellant impulse-density. This increase in volumetric efficiency is potentially significant to improve volumetric efficiency of hybrid propulsion systems.