World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:17, No:07, 2023

Heat Treatment of Additively Manufactured Hybrid Rocket Fuel Grains

Authors : Jim J. Catina, Jackee M. Gwynn, Jin S. Kang

Abstract : Additive manufacturing (AM) for hybrid rocket engines is becoming increasingly attractive due to its ability to create complex grain configurations with improved regression rates when compared to cast grains. However, the presence of microvoids in parts produced through the additive manufacturing method of Fused Deposition Modeling (FDM) results in a lower fuel density and is believed to cause a decrease in regression rate compared to ideal performance. In this experiment, FDM was used to create hybrid rocket fuel grains with a star configuration composed of acrylonitrile butadiene styrene (ABS). Testing was completed to determine the effect of heat treatment as a post-processing method to improve the combustion performance of hybrid rocket fuel grains manufactured by FDM. For control, three ABS star configuration grains were printed using FDM and hot fired using gaseous oxygen (GOX) as the oxidizer. Parameters such as thrust and mass flow rate were measured. Three identical grains were then heat treated to varying degrees and hot fired under the same conditions as the control grains. This paper will quantitatively describe the amount of improvement in engine performance as a result of heat treatment of the AM hybrid fuel grain. Engine performance is measured in this paper by specific impulse, which is determined from the thrust measurements collected in testing.

Keywords : acrylonitrile butadiene styrene, additive manufacturing, fused deposition modeling, heat treatment
Conference Title : ICSP 2023 : International Conference on Space Propulsion
Conference Location : Singapore, Singapore
Conference Dates : July 03-04, 2023