Additively Manufactured Low Cost Upper Stage Combustion Chamber

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ABSTRACT

Over the past two years NASA's Low Cost Upper Stage Propulsion (LCUSP) project has developed Additive Manufacturing (AM) technologies and design tools aimed at reducing the costs and manufacturing time of regeneratively cooled rocket engine components. High pressure/high temperature combustion chambers and nozzles must be regeneratively cooled to survive their operating environment, causing their design fabrication to be costly and time consuming due to the number of individual steps and different processes required. Under LCUSP, AM technologies in Sintered Laser Melting (SLM) GRCop-84 and Electron Beam Freeform Fabrication (EBF^3) Inconel 625 have been significantly advanced, allowing the team to successfully fabricate a 25k-class regenerative chamber. Estimates of the costs and schedule of future builds indicate cost reductions and significant schedule reductions will be enabled by this technology. Characterization of the microstructural and mechanical properties of the SLM-produced GRCop-84, EBF^3 Inconel 625 and the interface layer between the two has been performed and indicates the properties will meet the design requirements. The LCUSP chamber is to be tested with a previously demonstrated SLM injector in order to advance the Technology Readiness Level (TRL) and demonstrate the capability of the application of these processes. NASA is advancing these technologies to reduce cost and schedule for future engine applications and commercial needs.