PROJECT SUMMARY 5513.001

Thermal Aging Study for Additively Manufactured F357 Aluminum

Thermal treatments and service temperature effects on F357 aluminum processed on the EOS M290 and SLM M280 LPBF systems

EOS M290 LPBF system printing samples with completed print.

PROBLEM

There are a number of sustainment critical parts that have historically been produced using titanium alloys for their high strength capabilities. Titanium is however expensive and difficult to machine. High strength aluminum alloys such as F357 make it possible to pursue high temperature applications such as heat exchangers at substantial cost savings. Laser powder bed fusion (LPBF) technology has shown promise in producing high strength components in aluminum alloys, achieving comparable specific strength. Unfortunately, there is not a wealth of public data to help the adoption of F357 aluminum as an additive manufacturing material.

OBJECTIVE

The objective of this program is to enable the use of aluminum alloys for high temperature applications by understanding the effects of thermal treatments and service temperatures on the long term performance of this alloy. Specifically, this effort seeks to document the material state and microstructure of F357 aluminum for certification and qualification of components that are critical for sustainment of legacy defense systems.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

MATERIAL

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
EOS M290 L-PBF system , SLM M280 L-PBF system

MATERIAL
F357 Aluminum

TECHNICAL APPROACH

The University of Texas at El Paso (UTEP) is leading the effort. The first phase involves material parameter verification including powder acquisition and characterization, material parameter validation, and the builds of sample analysis cubes for characterization. Up to five post processing techniques for heat treatment are being investigated resulting in a down-selection for examining the thermal treatments and service temperature effects on F357 aluminum. Tensile samples are being constructed in the EOS M290 and SLM M280 system in the Z and XY orientations. Specimens are post processed in the "as built," T6, HIP, HIP +T6 states, with up to two additional heat treatment identified and developed. Subsequently 100 and 1000 hours of exposure at an aging temperature of 350°F are being studied.

PROJECT START DATE

November 2020

EXPECTED END DATE

April 2022

DELIVERABLES

- Design, test, build plan
- Material characterization data package
- Final report

FUNDING

$276K total project budget
($137K public funding/$139K private funding)

PROJECT PARTICIPANTS

Project Principal:
University of Texas, El Paso

Other Project Participants:
Air Force Research Laboratory

Public Participants:
U.S. Department of Defense