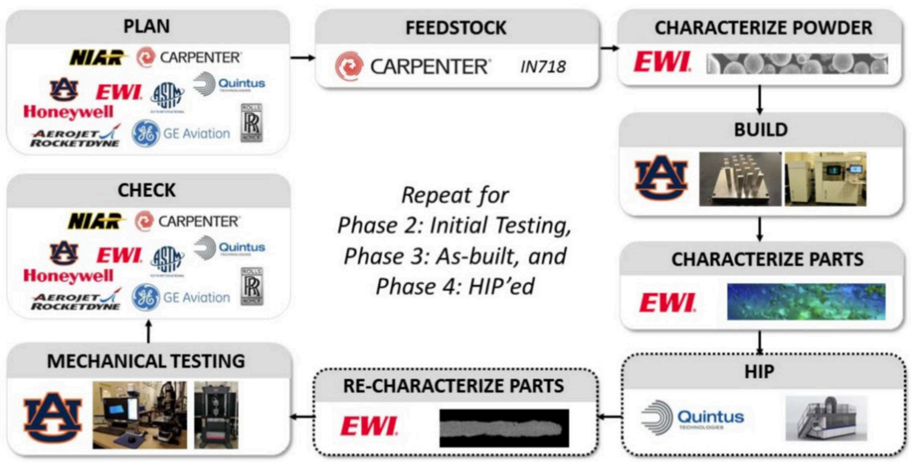
Advancing AM Post Processing Techniques (AAPT)



Utilizing a "Plan-Do-Act" methodology for developing an understanding of the mechanical debits associated with HIP vs. non-HIP LPBF IN718 parts.

PROBLEM

The cost/benefit of hot isostatic pressing (HIP) and surface finish is not understood. The typical approach for IN718 components is to HIP, however this process drives up part cost and lead times and eliminates the potential for the adoption of additive manufacturing processes for flight components due to the high costs associated with part qualification. There is generally a lack of best practices for post processing of components made by additive manufacturing (AM), which is a key missing link in the process-structure-property-performance relationships. A quantitative understanding of the HIP process would enable a cost benefit-based design and manufacturing decision, reducing the cost of product development and simplifying qualification.

OBJECTIVE

The objective of this project is to determine and enable the use of quantitative mechanical performance debits for both as-built and HIPd thin walled components and components with narrow flow channels by generating and validating a high-pedigree, coupon-level dataset, using commercially available manufacturing and post manufacturing process parameters. A further goal is to publish draft standards that enable a reduction in qualification and certification cost and time and maximize industrial relevance.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP	This project aligns to: PROCESS	ASTM PROCESS CATEGORY: Powder Bed Fusion	EQUIPMENT: EOS M290 (400W)	MATERIAL: Inconel 718 (IN718)

TECHNICAL APPROACH

This work is being guided by Aerojet, GE, Honeywell, Rolls-Royce, and Raytheon. The technical approach is to fabricate test specimens using IN718 due to the availability of process parameter sets and industrial need and relevance. These parts are being fabricated with an EOS M290-400W system, utilizing default EOS process parameters for IN718, in an argon build environment with 40-µm layers.

Specimens are being fabricated with minimum support structure and are being HIPd utilizing standard process parameters.

The project plan is to progress through four "plan-do-check" cycles:

1. Initial testing to validate methods, including HIP, computed tomography (CT), optical metrology, and mechanical testing;
2. As-built coupon testing;
3. HIP coupon testing;
4. Validation by burst testing thin wall components, with narrow flow channels.

PROJECT START/END DATE

February 2019 - May 2021

EXPECTED DELIVERABLES

- Data management plan
- Test matrix and test artifact design
- Data management review
- Report summarizing validations measurements performed and test plan modifications
- Validation datasets
- High pedigree datasets
- Report summarizing analysis results
- High pedigree datasets
- Report summarizing analysis results
- Data management review
- Draft standards
- Report comparing burst testing to expectations based on mechanical performance debits

FUNDING

$1.2M total project budget
($800K public funding/$400K private funding)

PROJECT PARTICIPANTS

Project Principal:
Auburn University

Other Project Participants:
EWI
National Institute for Aviation Research
ASTM International
Carpenter
Quintus Technologies
NASA
AeroJet Rocketdyne
GE Aviation
Honeywell
Raytheon
Rolls Royce

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