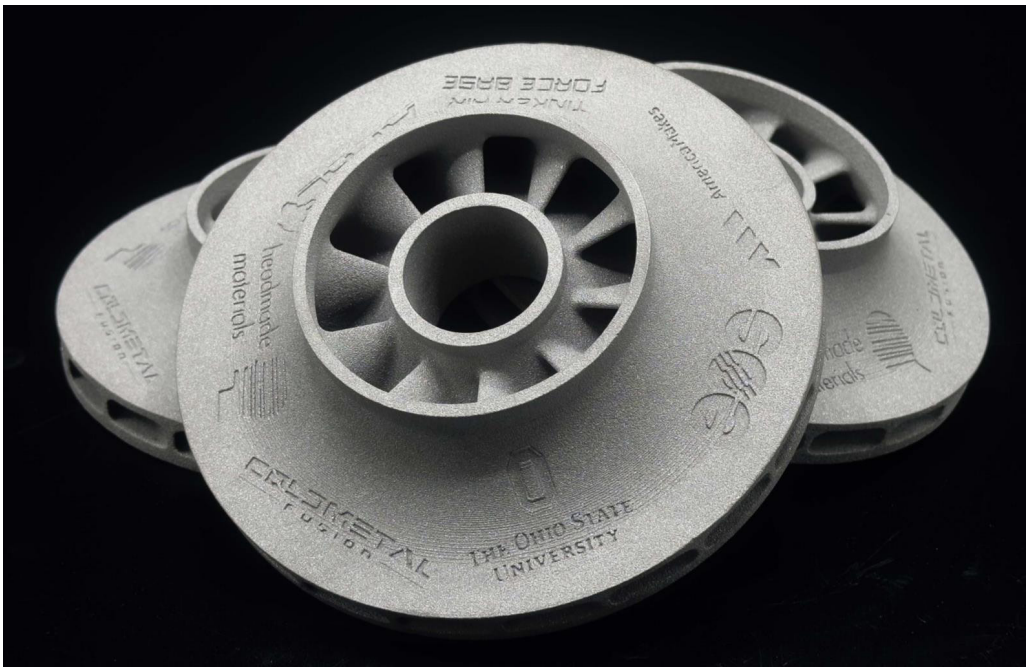
SUCCESS STORY 5551

Project demonstrated printability of Ti6Al4V material using cold metal fusion process on an EOS P110 polymer selective laser sintering printer

Printability study on cold metal fusion proves viable for Air Force sustainment and repair



Demonstration impeller that highlights the capabilities of the cold metal fusion print process.

PROBLEM

The Department of Defense (DoD) industrial base continues to adopt advanced manufacturing technologies that enhance the readiness and effectiveness of the United States military. Additive Manufacturing (AM) adoption is creating new opportunities to provide advanced technical solutions to the warfighter. However, material qualification, material cost, and overall process efficiencies are limiting AM's broader implementation. Cold metal fusion can provide a more efficient and cost-effective solution, but testing of this emerging process is limited. Further testing is necessary to validate the process and inform the larger DoD industrial base.

OBJECTIVE

The project objective was to develop and demonstrate a cold metal fusion printing process through manufacturing and testing Ti6Al4V specimens. The team created three manufacturing builds to verify machine parameters and assessed part performance. This included one demonstration component recommended through collaboration between The Ohio State University (OSU) Center for Design and Manufacturing Excellence (CDME) and the Tinker Air Force Base (AFB) Reverse Engineering and Critical Tooling (REACT) Laboratory. The team developed a technology overview and final report that provided the DoD with insight into the feasibility and potential of cold metal fusion technology.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to: PROCESS

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
EOS P110

MATERIAL
Ti6Al4V

TECHNICAL APPROACH

To investigate and evaluate cold metal fusion, the research team performed four separate tasks. Task 1 commissioned the EOS P110 while concurrently drafting a 10-page technology overview submitted at the end of the project. Further, the team compared the productivity and design criteria to that of similar modalities (metal injection modeling). Task 2 created three manufacturing builds from Ti6Al4V material, verified machine parameters, and assessed part performance. The first build specimen was geared toward parameter development and the second build specimen consisted of mechanical test specimens (tensile and fatigue). OSU CDME and the Tinker AFB REACT Laboratory collaborated to determine a demonstration component to use as the third test specimen. Task 3 measured the green and final part densities, conducted tensile testing, and performed basic material characterization to assess the mechanical properties of the produced parts. Finally, Task 4 consolidated all the findings from the previous tasks into a comprehensive final report. The final report serves as a valuable resource for the DoD and its supply chain, providing insights into the feasibility and potential of cold metal fusion technology.

ACCOMPLISHMENTS

OSU CDME successfully demonstrated Ti6Al4V's printability using the cold metal fusion process on an EOS P110 polymer selective laser sintering (SLS) printer. This project was one of the first, cold metal fusion printability studies conducted in the U.S. Printability was demonstrated through the manufacturing of tensile bars, coupons, and demonstration components. Mechanical analysis results of the tensile bars and coupons mirrored ultimate strength, yield strength, and microstructure values for Ti6Al4V material printed in other modalities. Demonstration components illustrated the printing capabilities of the cold metal fusion modality, including the ability to print fully supportless structures. Additionally, OSU CDME drafted a technology overview summary to educate the DoD community on this new AM modality and to compare it to other similar AM modalities.

PROJECT END DATE

April 2024

EXPECTED DELIVERABLES

- Technology overview summary in PowerPoint
- Conduct three manufacturing builds including test specimen for evaluation
- Part densities (green and final), tensile (12 specimen minimum), fatigue (5 specimen minimum), and witness coupon microstructure from each build
- Technical report and presentation at a public forum

FUNDING

$225,000 total project budget

PROJECT PARTICIPANTS

Project Principal:
The Ohio State University Center for Design and Manufacturing Excellence (CDME)

Project Participants:
America Makes
NCDMM
Air Force Research Laboratory (AFRL)
Air Force Sustainment Center
EOS
Headmade Materials

Public Participants:
U.S. Department of Defense