Amit Kumar, PhD

McGill University

Materials Researcher| Laser Powder Bed Fusion

Specialist | Expert on Thermo-Mechanical

Simulation | AI & ML Applications

Last: update December 2024



About Amit

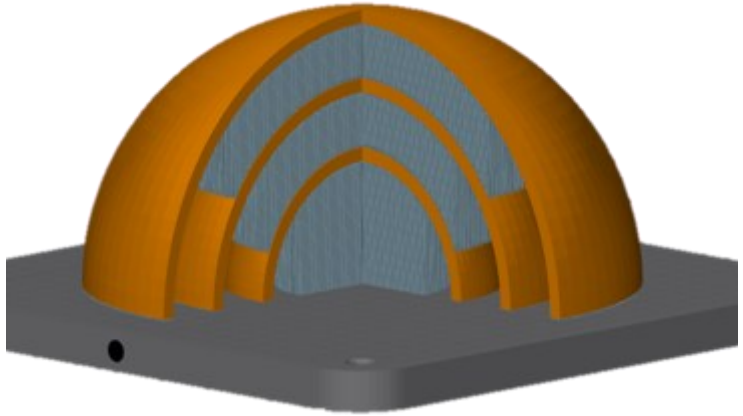
- Materials engineer with over **10 years** of experience in academic research, **industrial R&D**, technical writing, and project management.
- Specialized in laser processing, including Laser Powder Bed Fusion (LPBF) metal additive manufacturing, with expertise in optimizing laser strategies for complex geometries.
- Notable achievements include developing innovative **support-free fabrication techniques** for LPBF and extensive experience with multi-kilowatt laser systems, automation, and laser micromachining.
- Proficient in both experimental characterization and numerical simulation of alloy systems under various thermomechanical processes.
- Proven track record with **15 journal** publications, **7 international conference** presentations, **and 2 patents.**

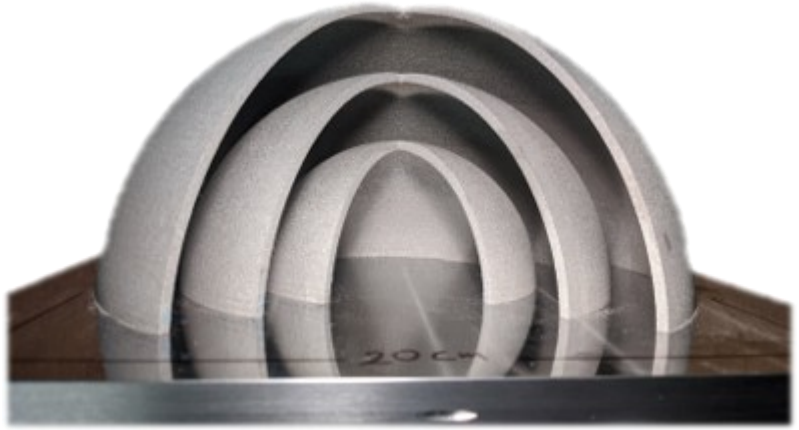
Work on Support Free Laser Support Free Fabrication via laser processing

- Demonstrate the ability to do innovation, conduct research to meet the industrial standards, in-depth knowledge of materials, and strong technical writing capability.

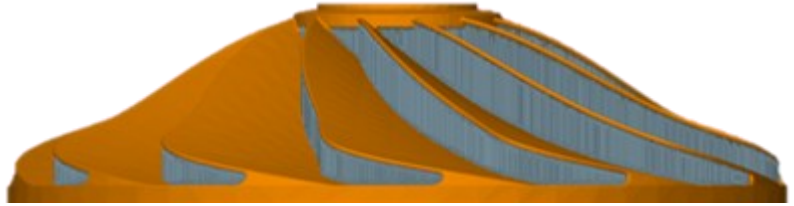


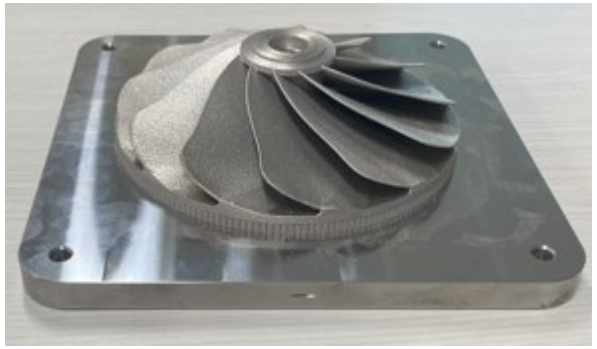
From Inception to Innovation: Cutting-Edge Support-Free Fabrication of Geometries



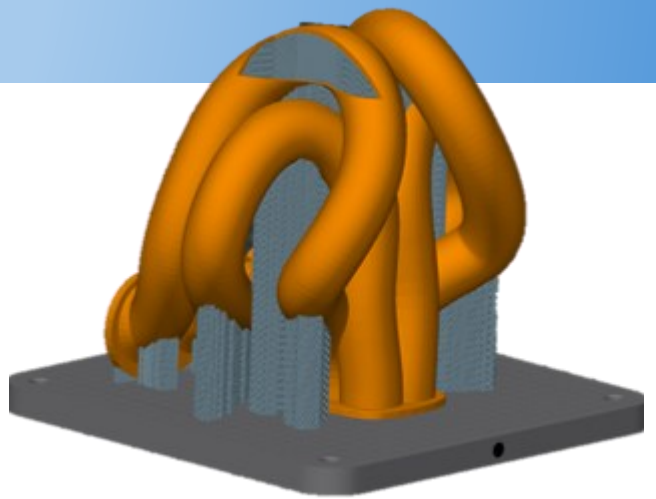


- 20-15-10 cm diameter half spheres.
- Printed in Summer 2019 (AM250).





- 18 cm diameter impeller, 1 mm thick and 11cm long unconstrained blade (lowest angle is 11°).
- Printed in Summer 2022 (500E).





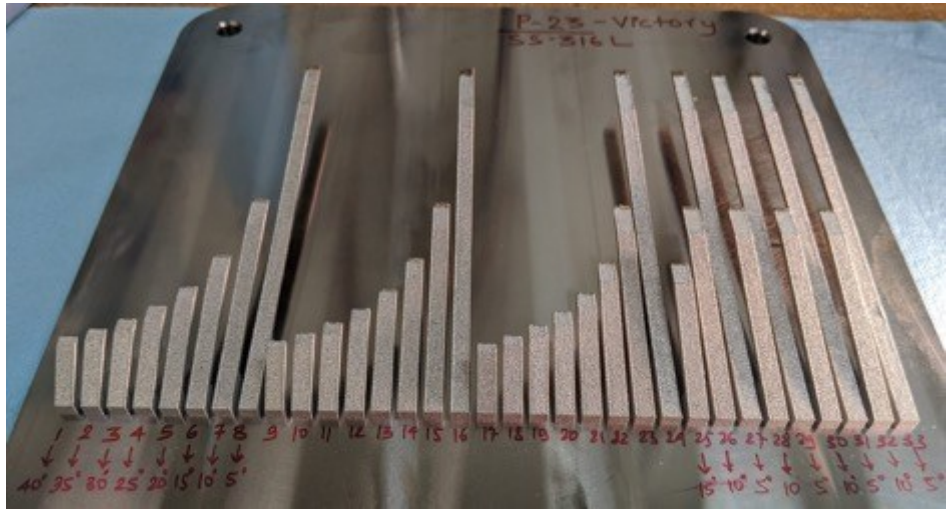
- 4-tubes manifold with 0° sections.
- Printed in fall 2022 (500E).

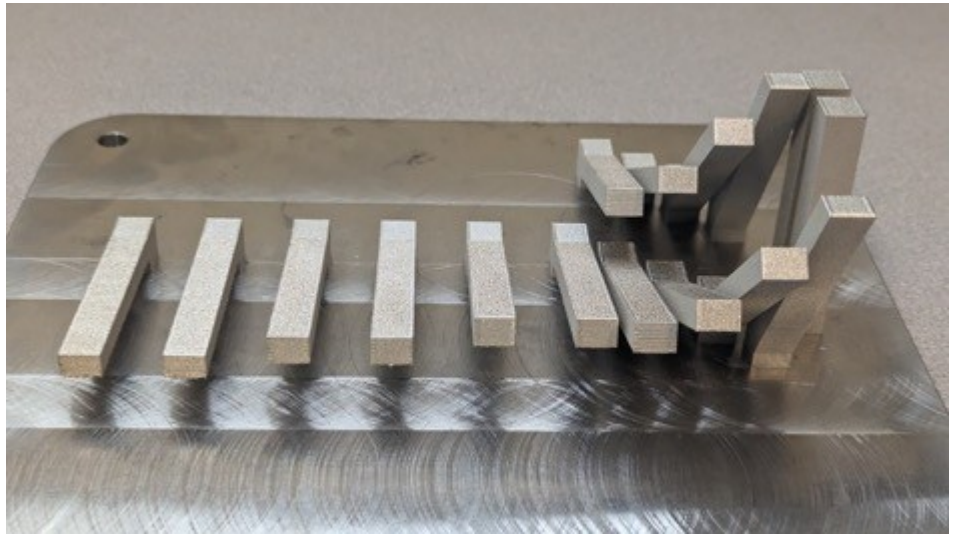
Low overhanging bars

Printing low angle walls and parts since 2019.

Walls from 0.5 to 5 cm in width and 2-6 mm in thickness down to 2° were printed in various materials:

- Ni-based alloys
- Fe-based alloys
- Al-based alloys



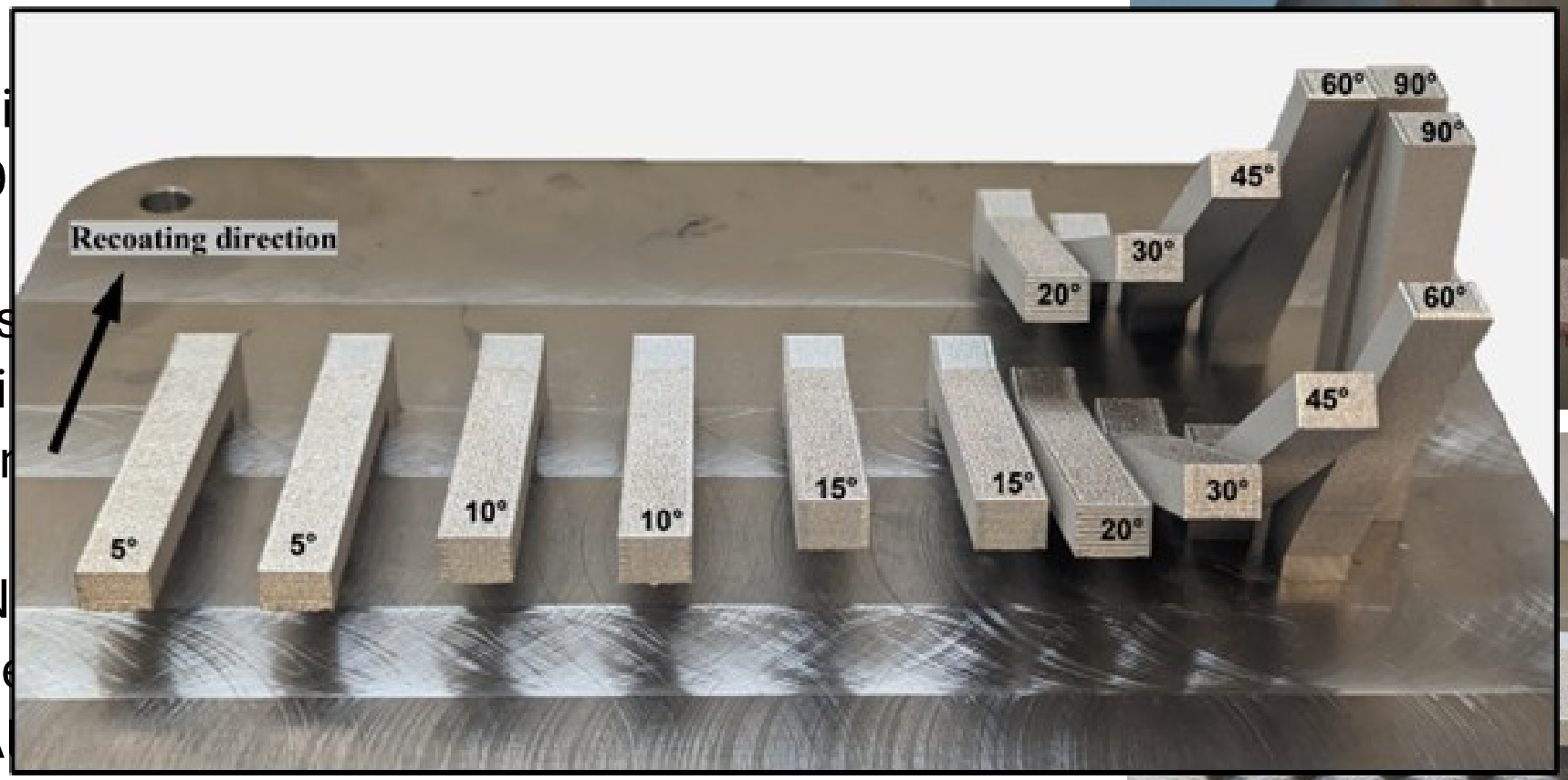


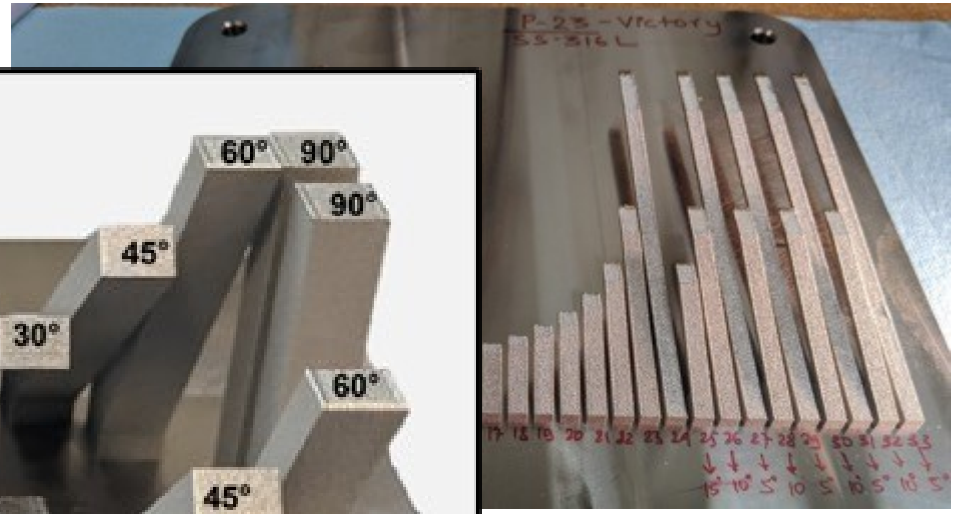
Low overhanging bars

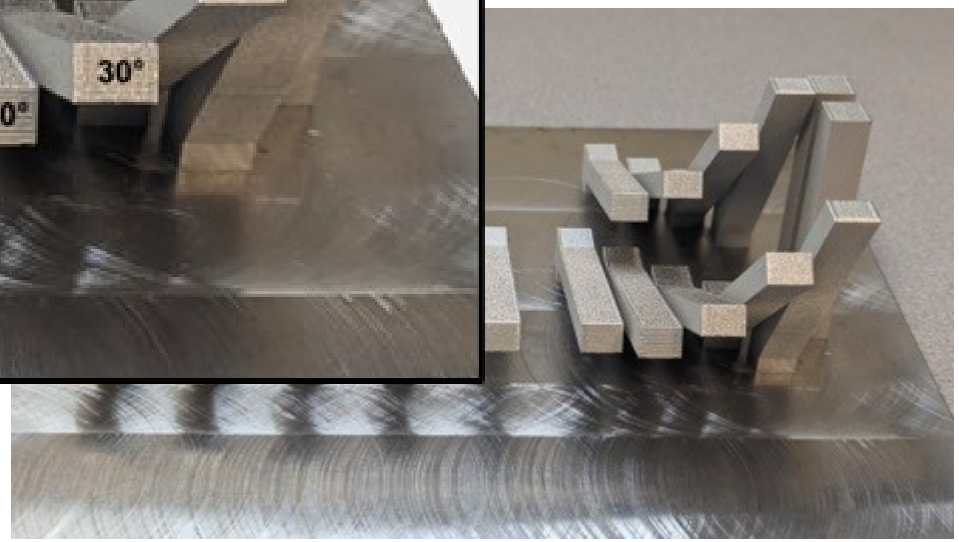
Printi
2019

Walls
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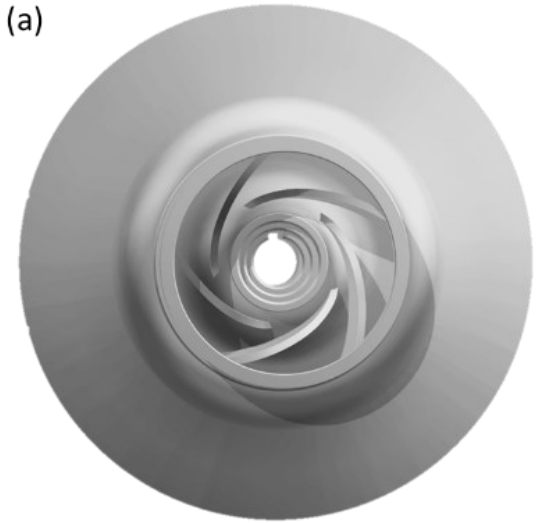
- N
- Fe
- Al

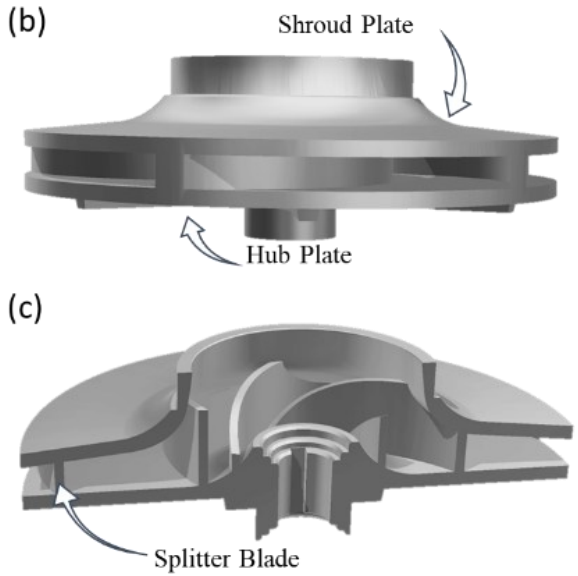


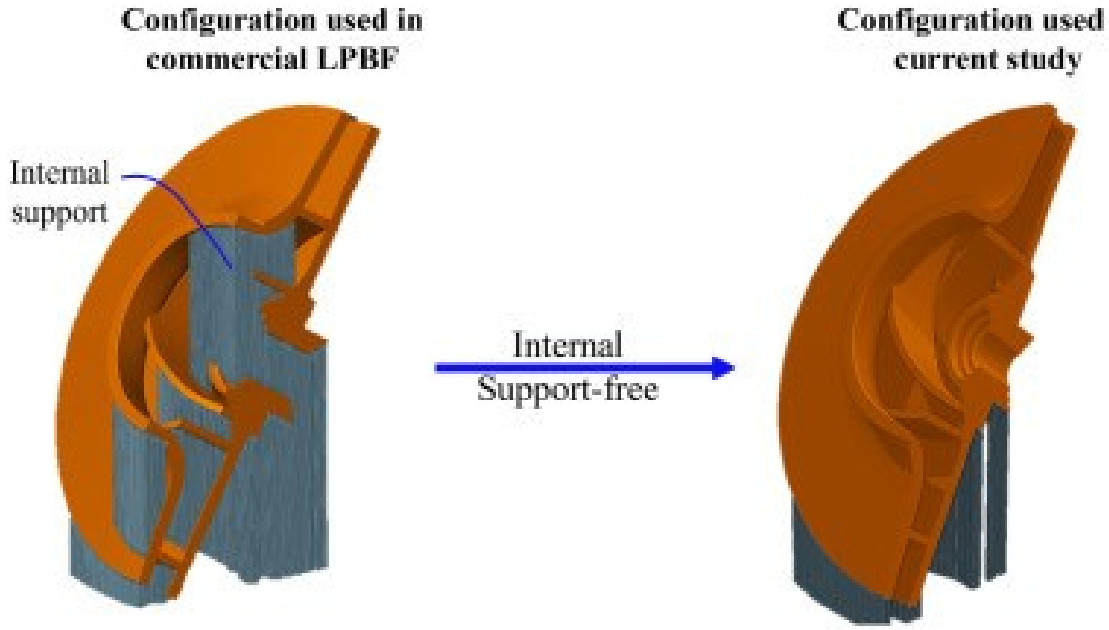




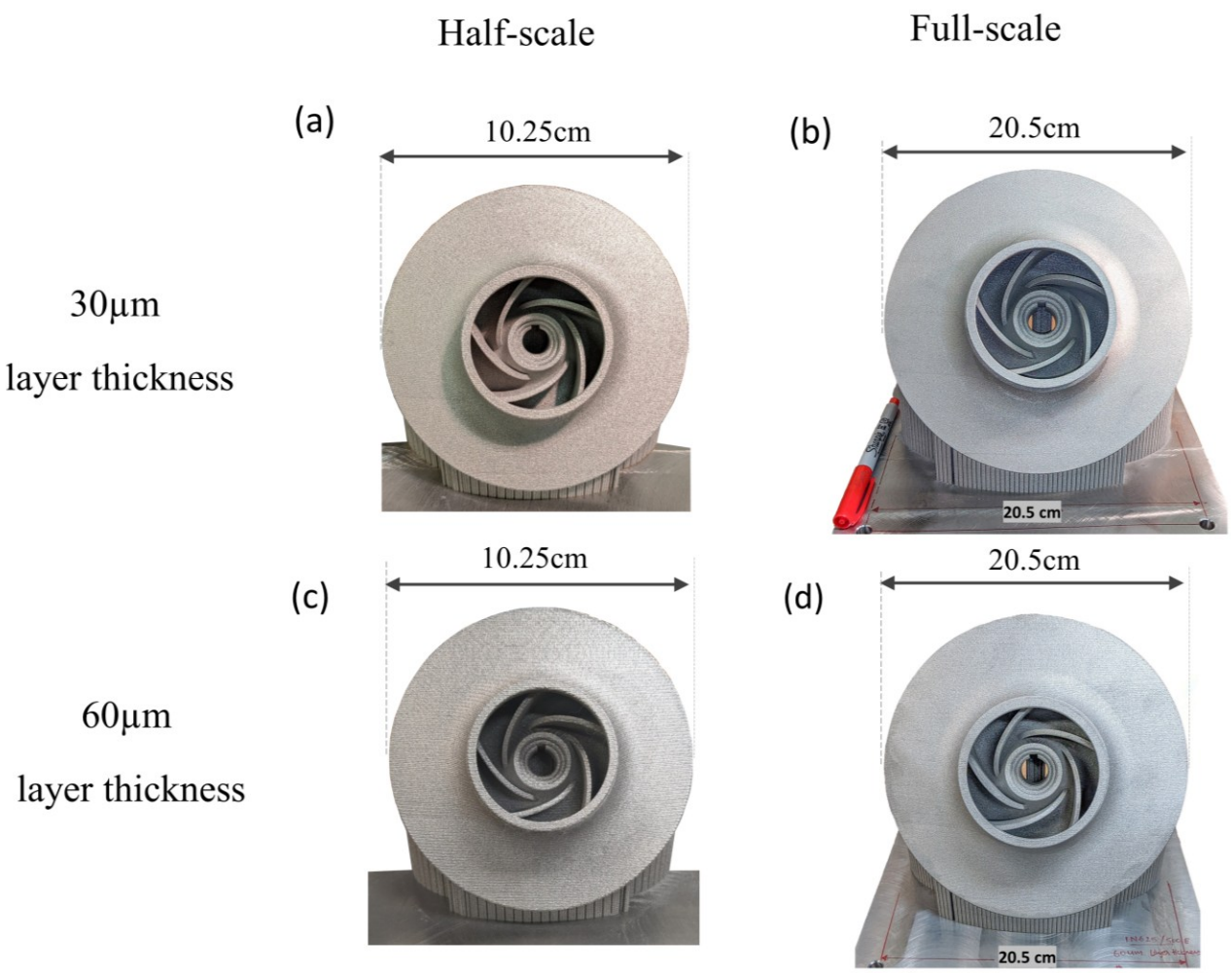
Support Free IN625 Closed Impeller design

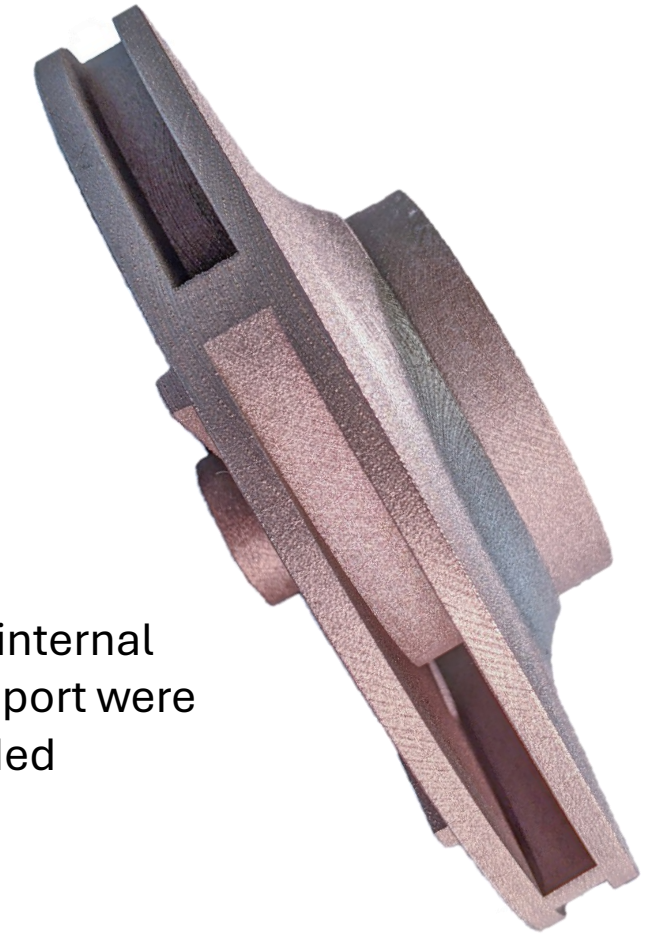






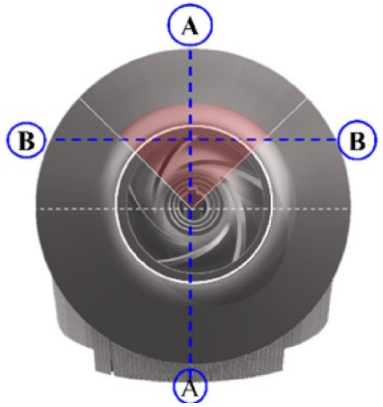
Support Free IN625 Closed Impeller design

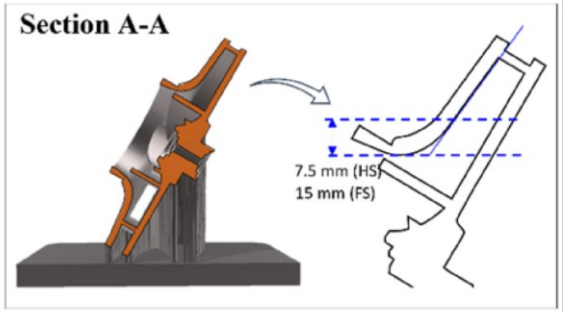


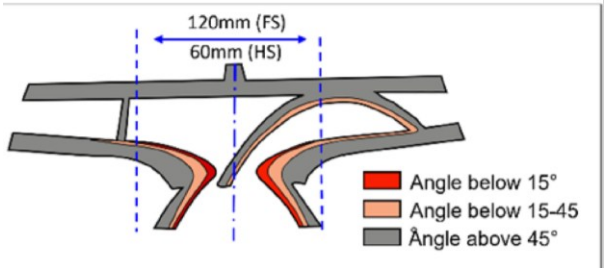


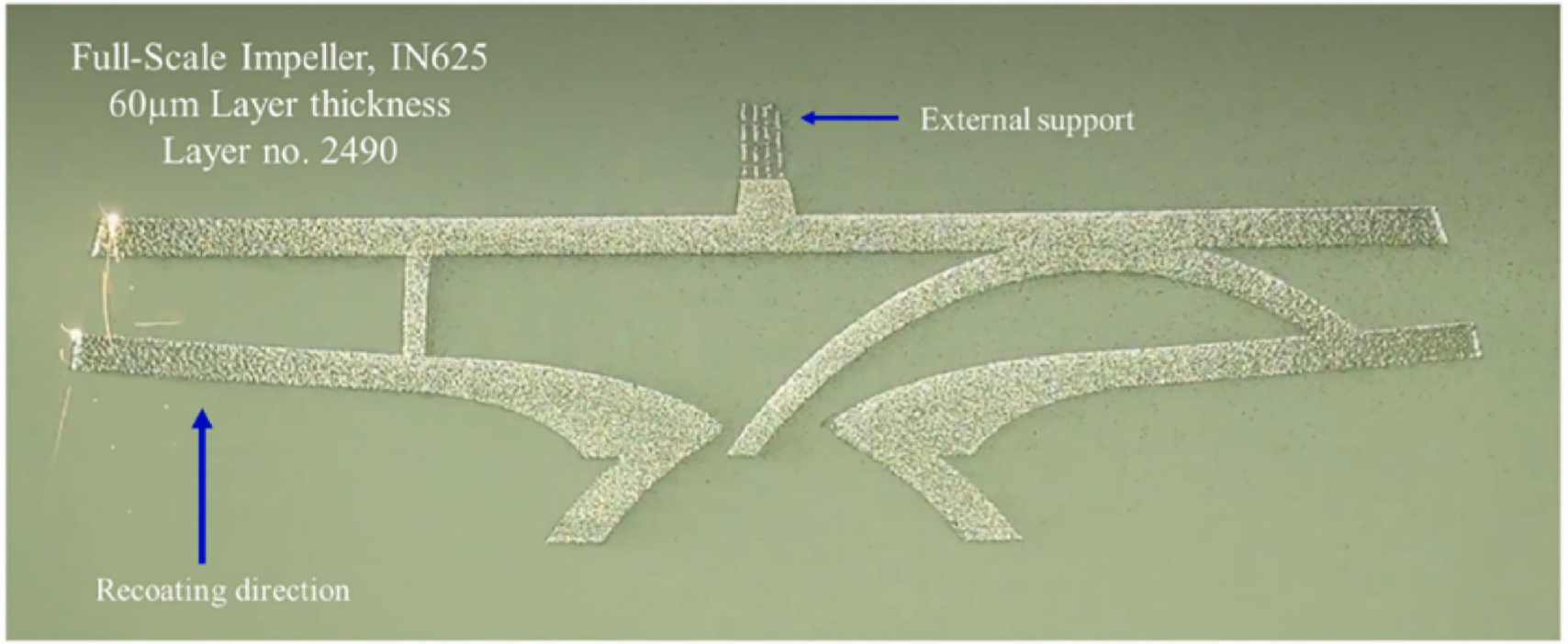
No internal support were added

Support Free IN625 Closed Impeller design

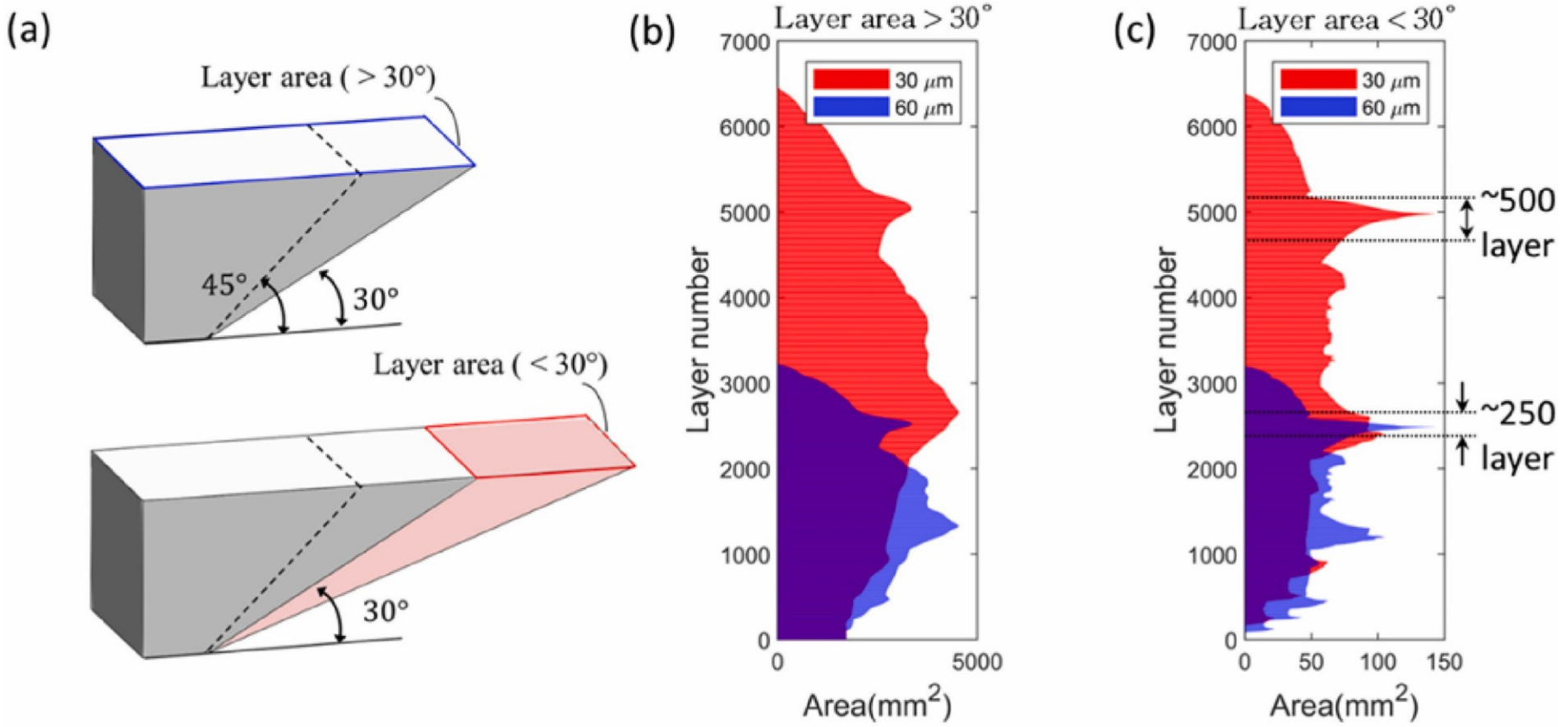




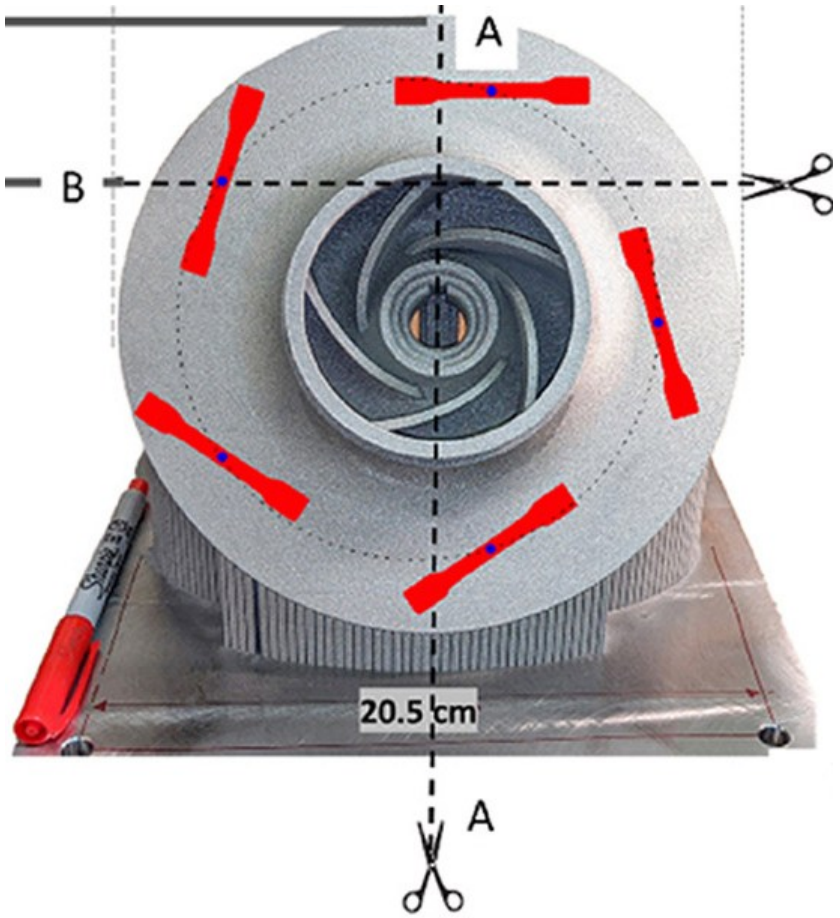


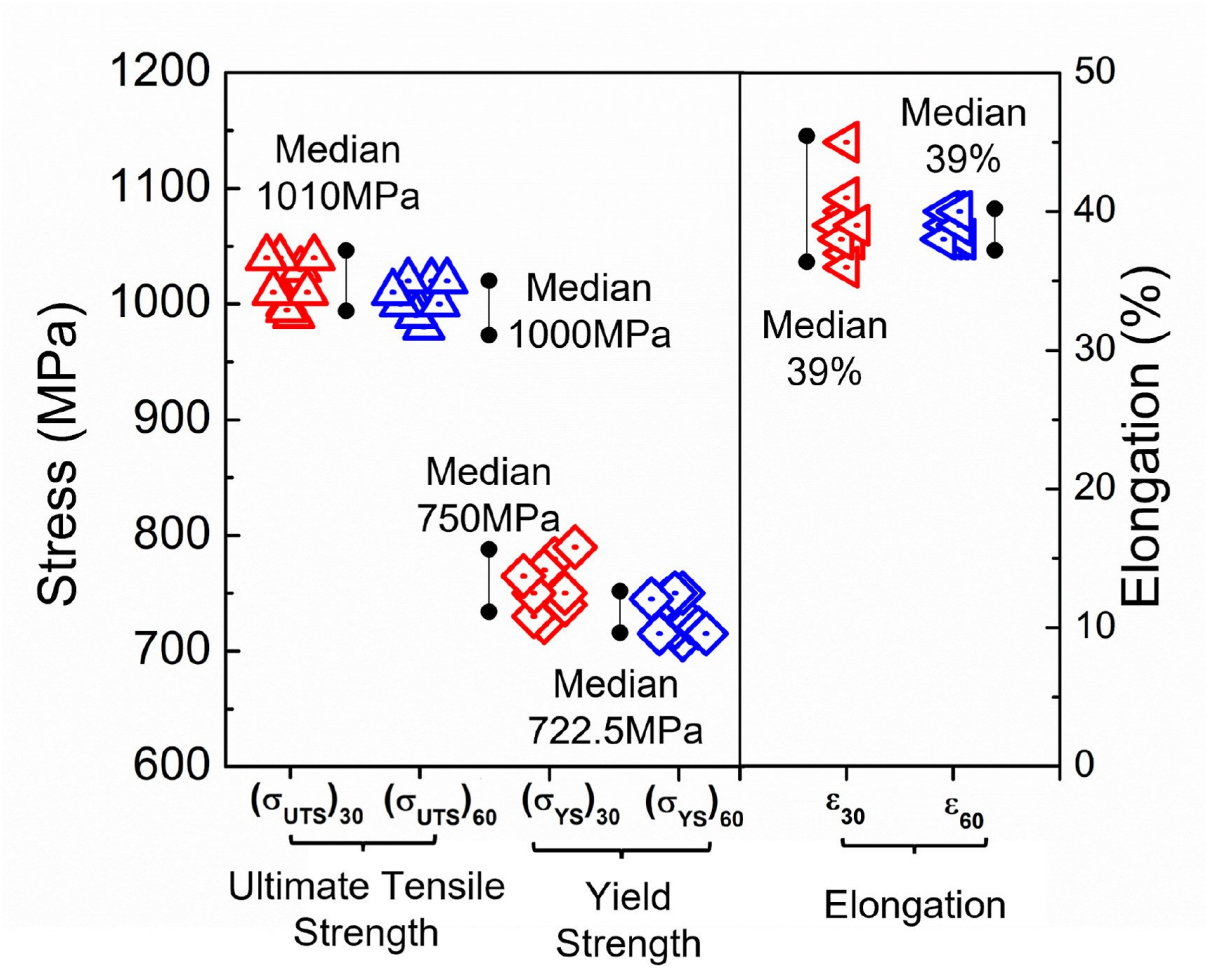


Support Free IN625 Closed Impeller design

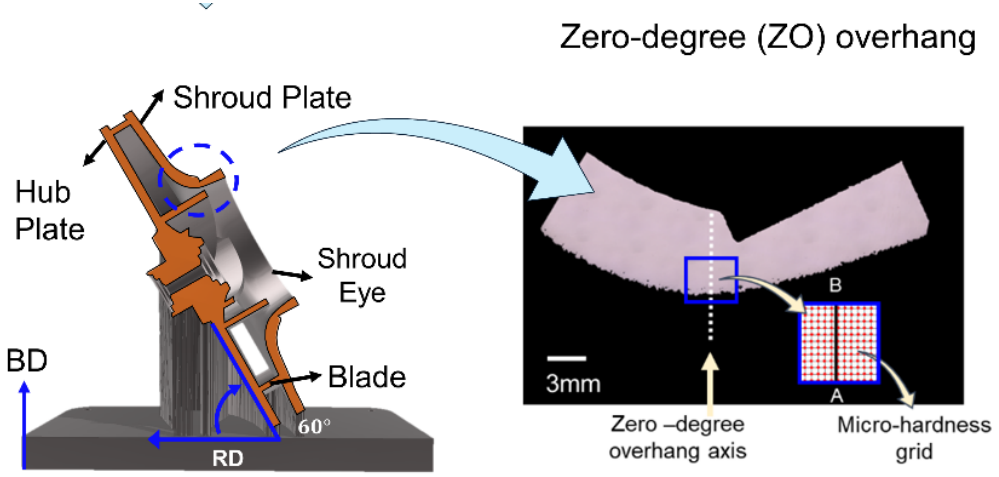


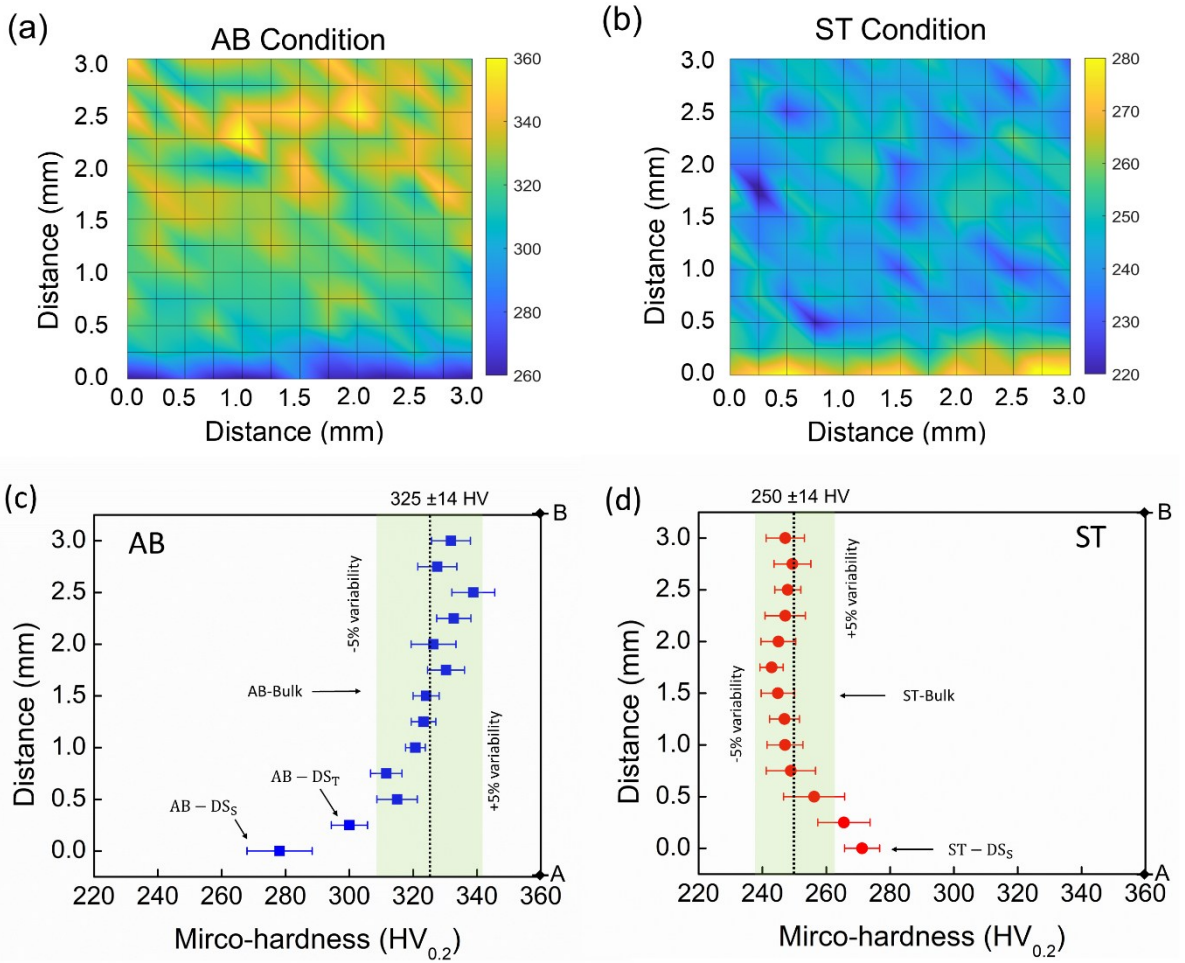
Support Free IN625 Closed Impeller design





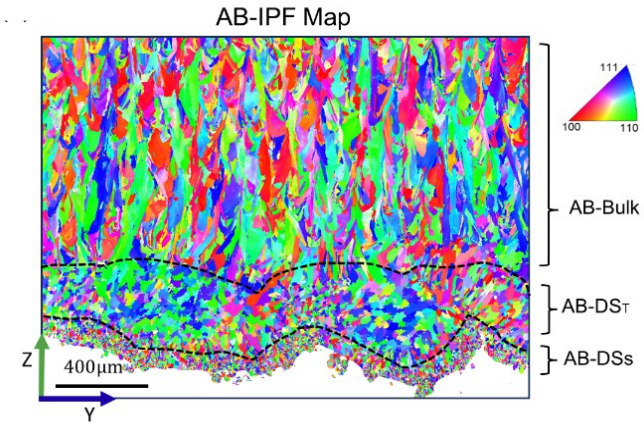
Solutioninzing heat treatment of closed impeller

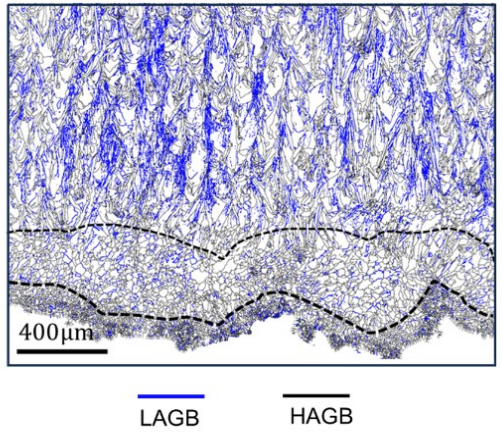


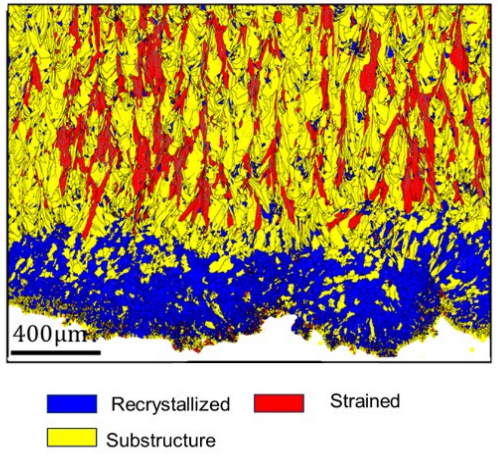


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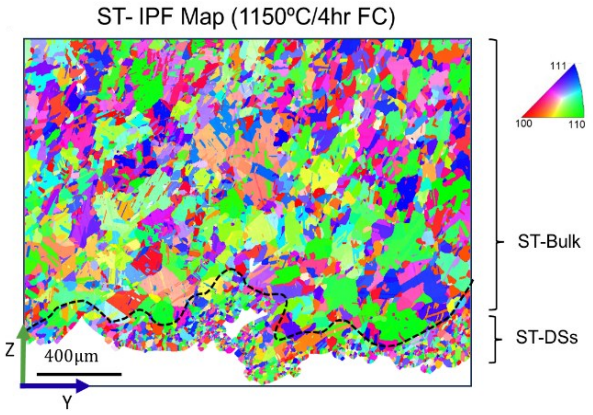
AS-Build Condition

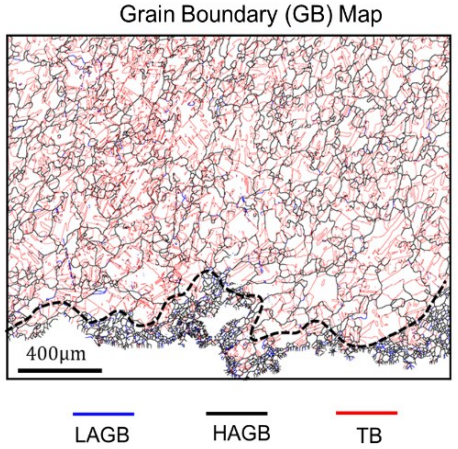


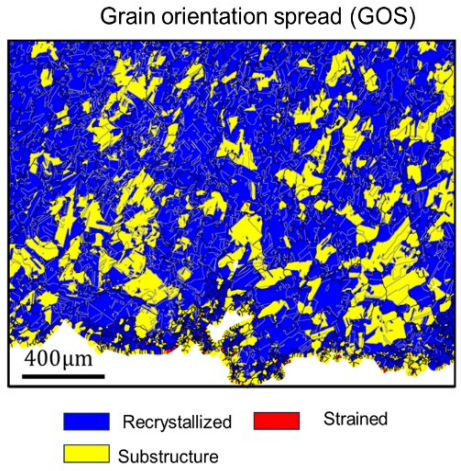




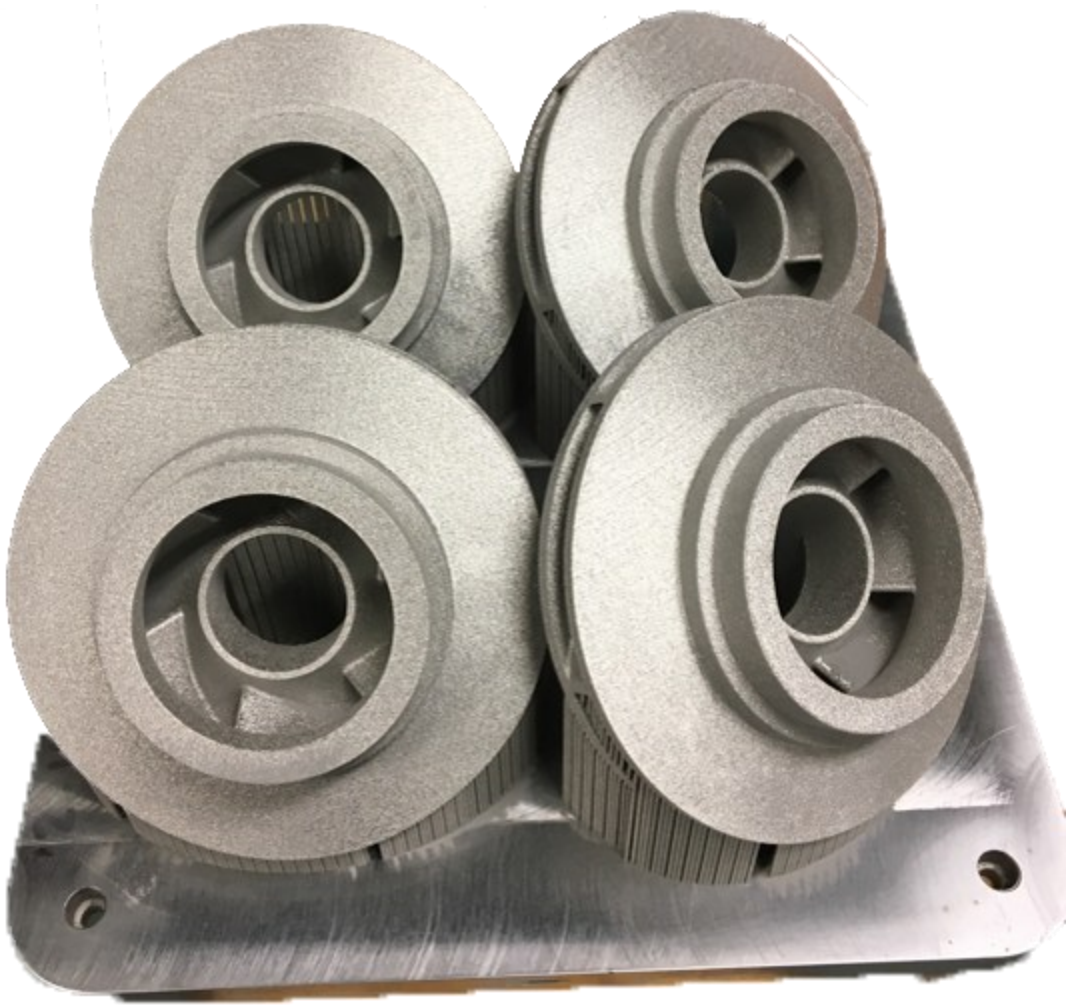
Solution Treatment Condition





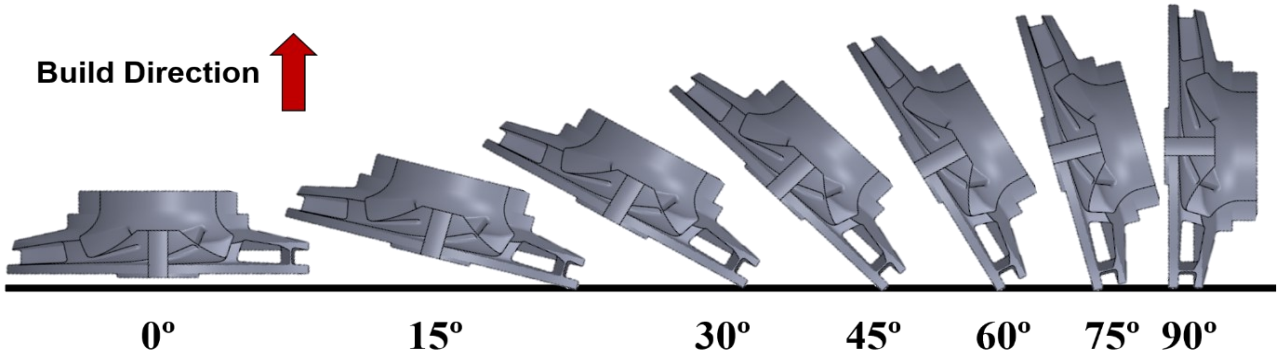


Orientation Study Closed Impeller



Case study performed in early 2023

- Rapid turnaround for repair of pump is key.
- Six splitter blades, so constant symmetry.

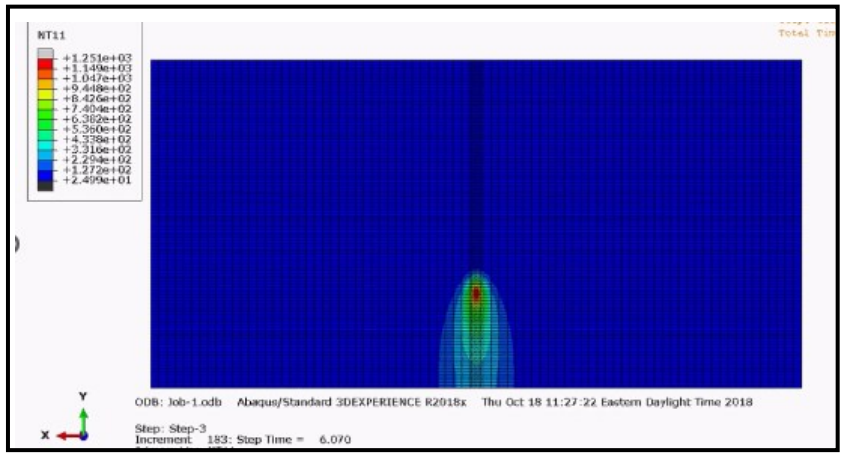


Some additional works in LPBF

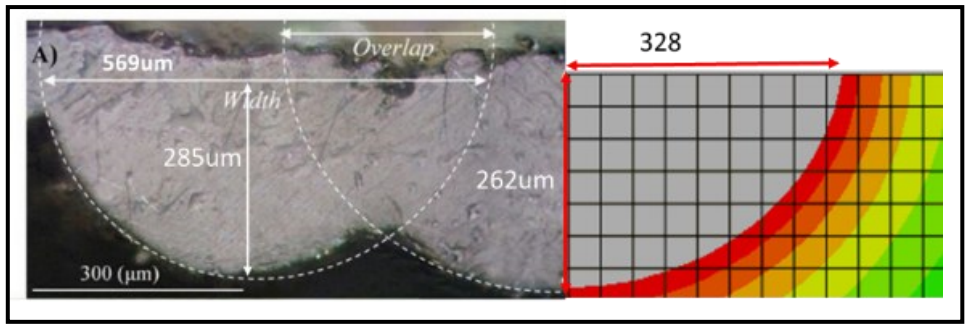


1. FEM Modeling of Laser Melting and Joining

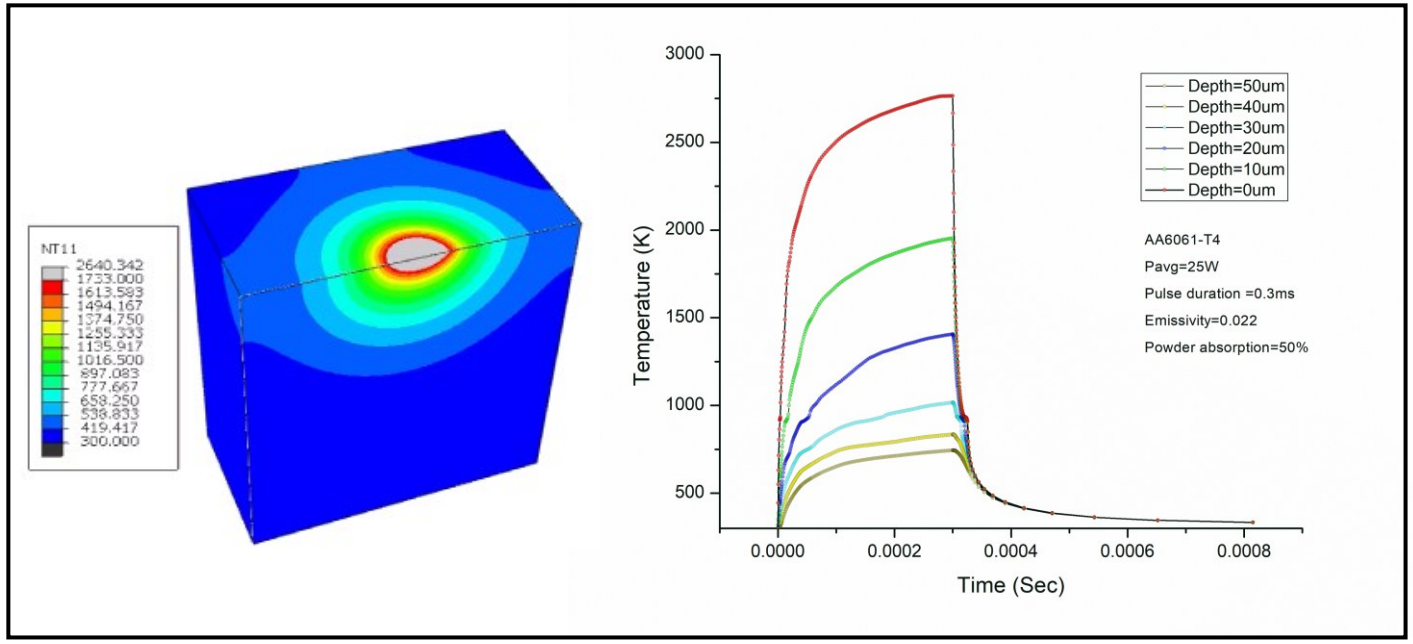
Thermal simulation for joining two Plates



Experimental validation of melt region

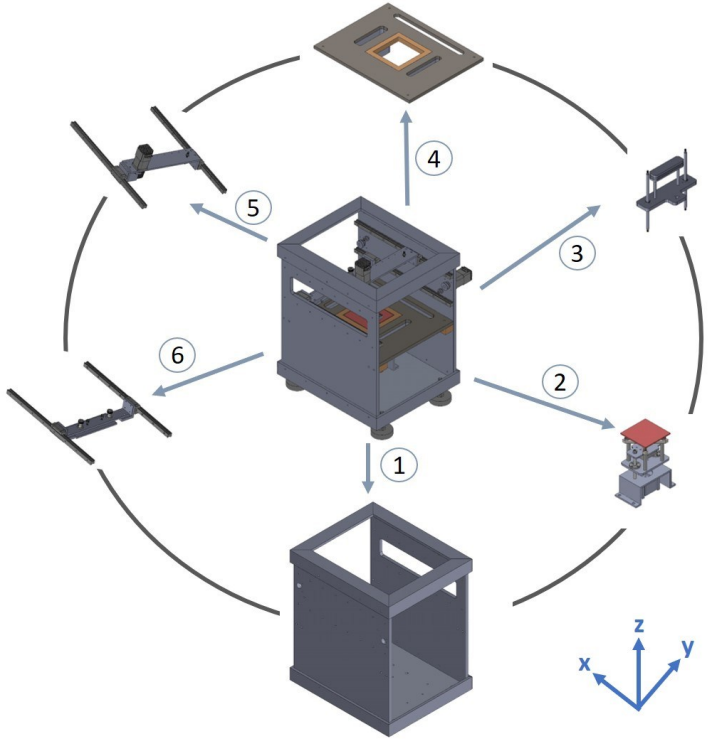


Thermal profile of the 6061 Aluminum alloy at different depths

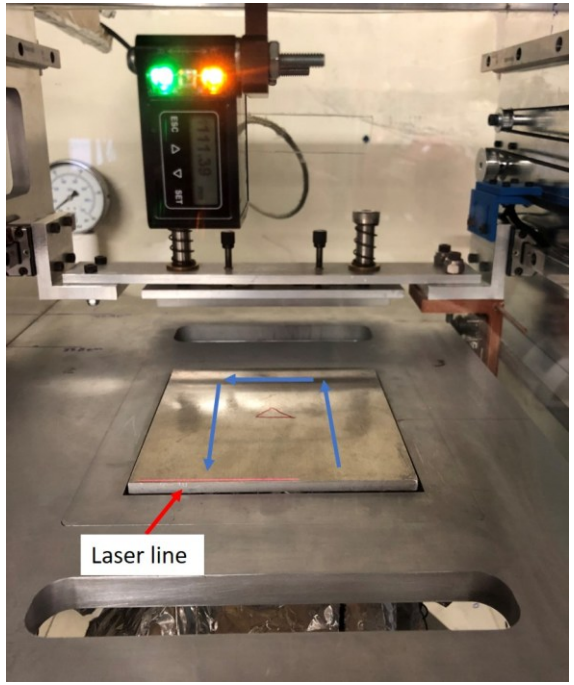


2. B3D Performance: Powder bed density characterization equipment

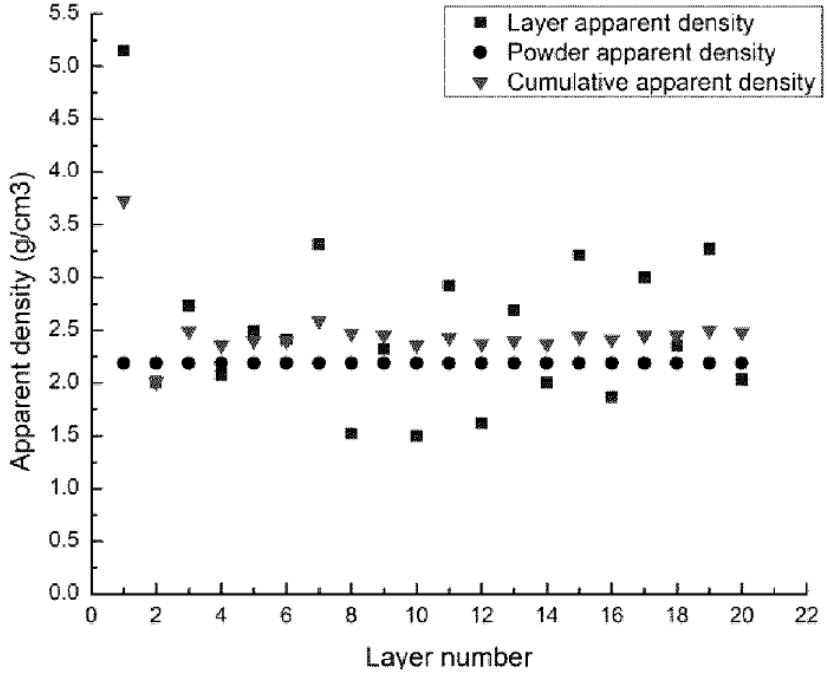
- **High-precision system with the capability to measure the apparent density of the spread powder layer from 10um to 200um**
- **Conceptualized, designed, and manufactured the equipment**



Machine setup



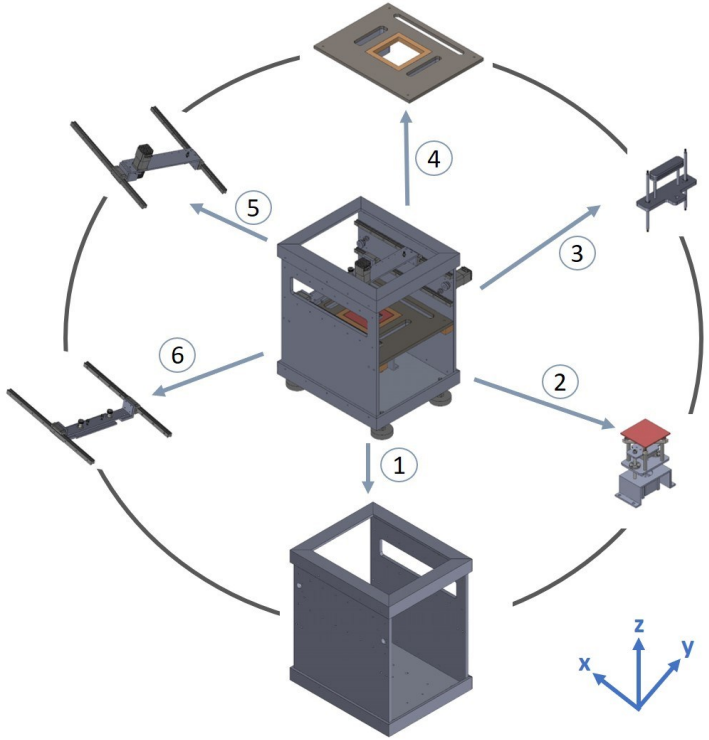
Inside Machine



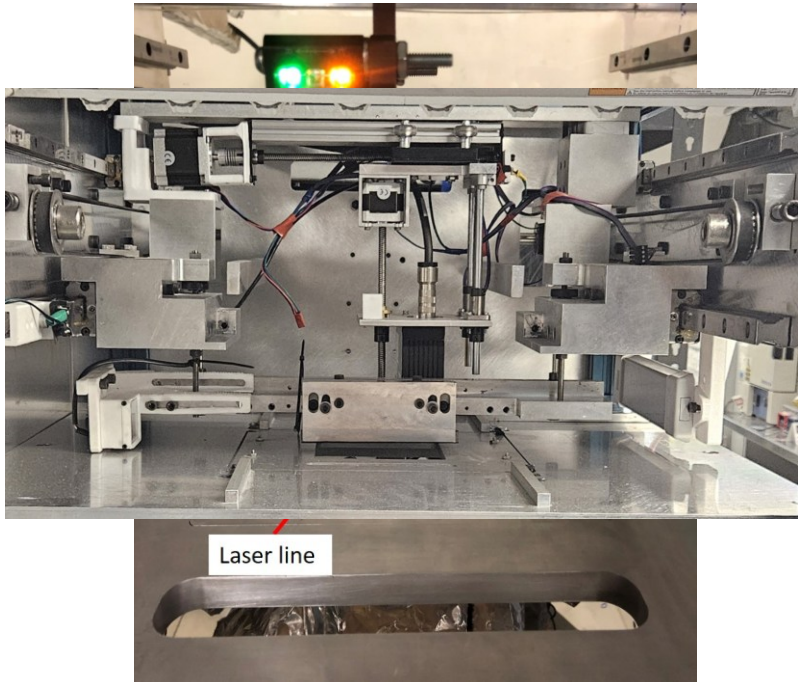
Repeatability and Apparent density (Al-alloy)

2. B3D Performance: Powder bed density characterization equipment

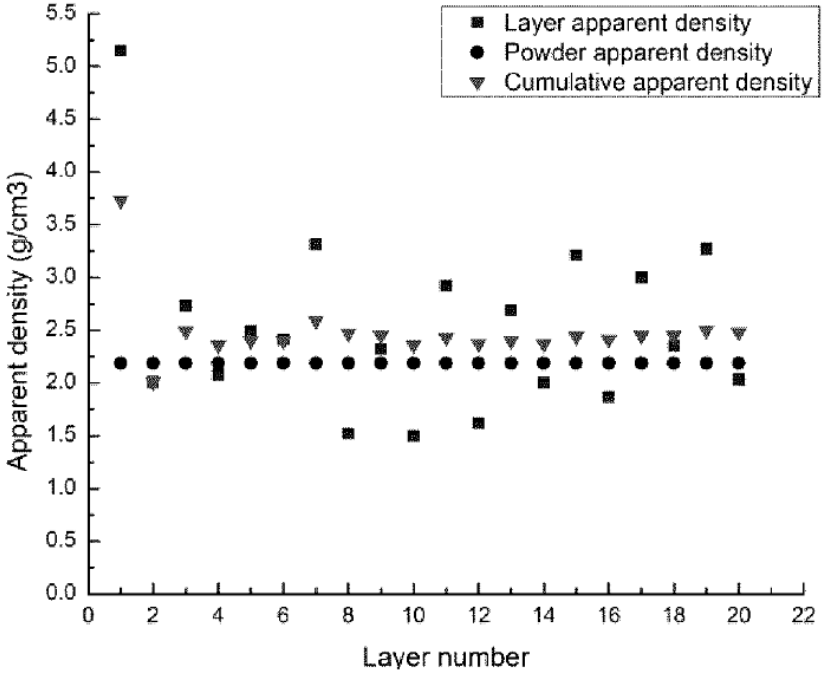
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Machine setup

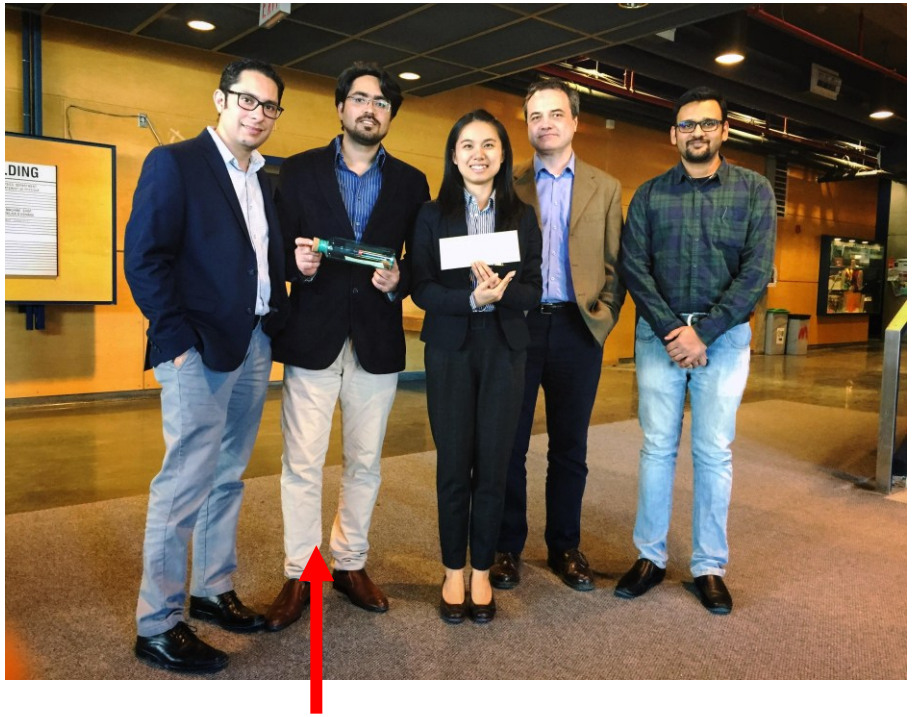


Inside Machine



Repeatability and Apparent density (Al-alloy)

2. B3D Performance : Powder bed density characterization equipment

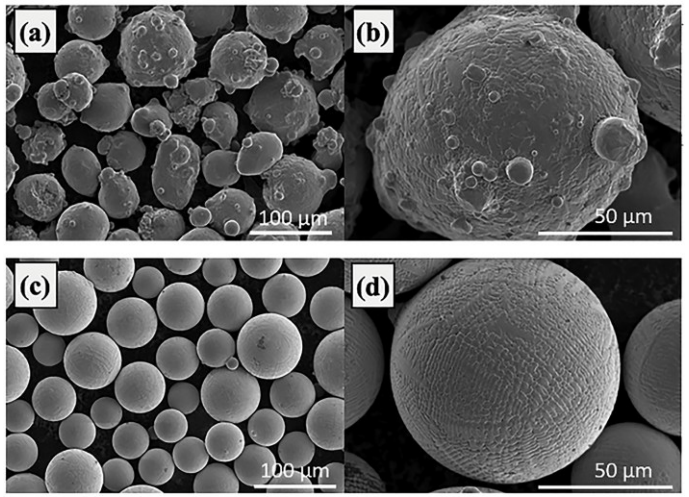


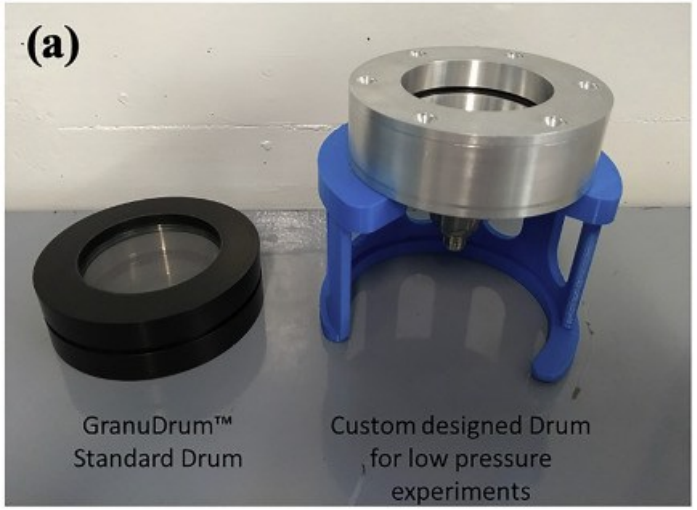
Won Dopson cup for sustainability and innovation

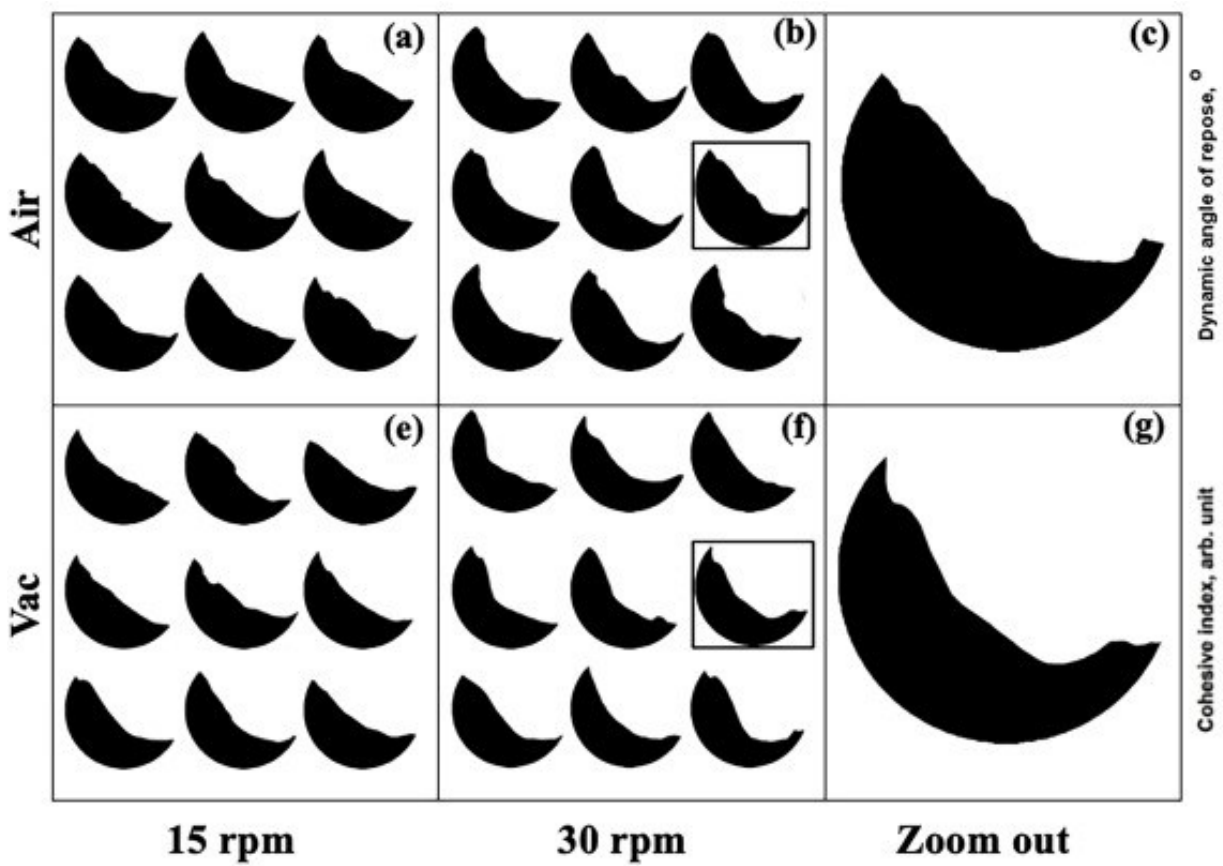


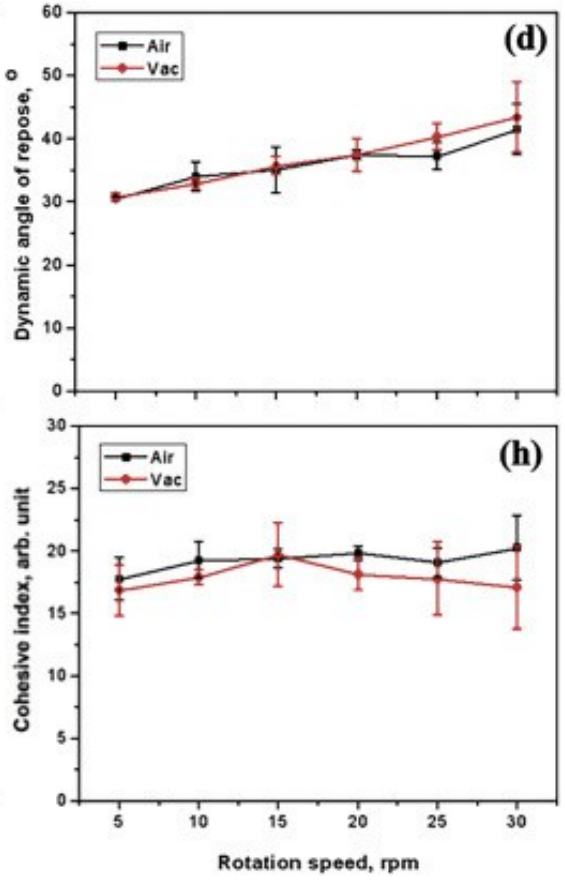
B3D Performance Won 500k Canadian dollars from CNRC for expansion

3.Vacuum rotating drum technique to characterize aluminum powder flow



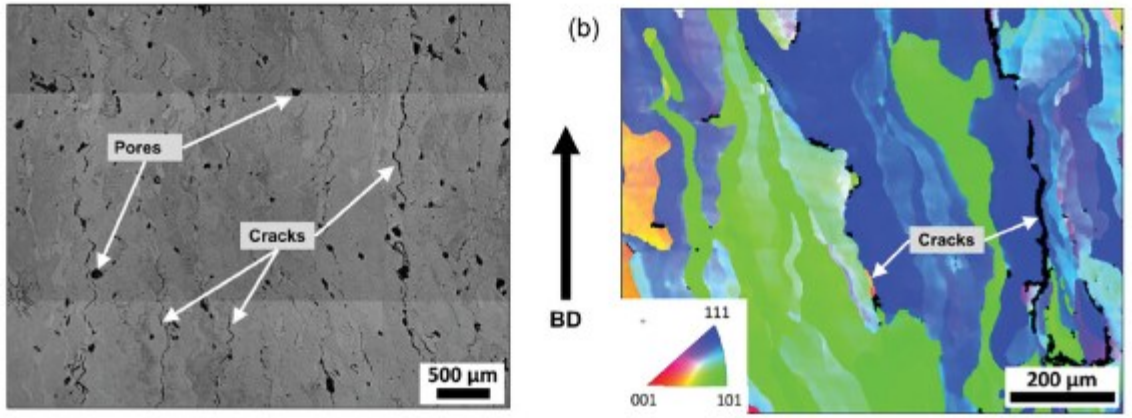




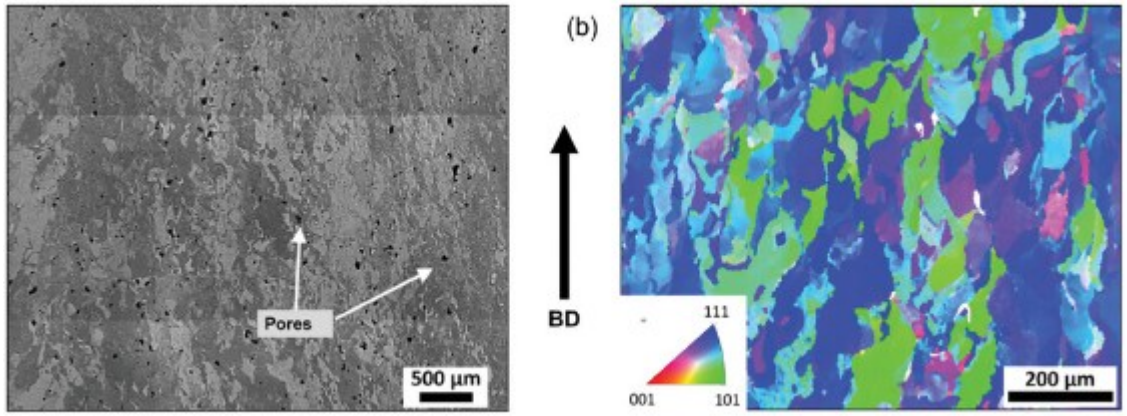


4. Crack-Free Tungsten Fabricated under laser melting

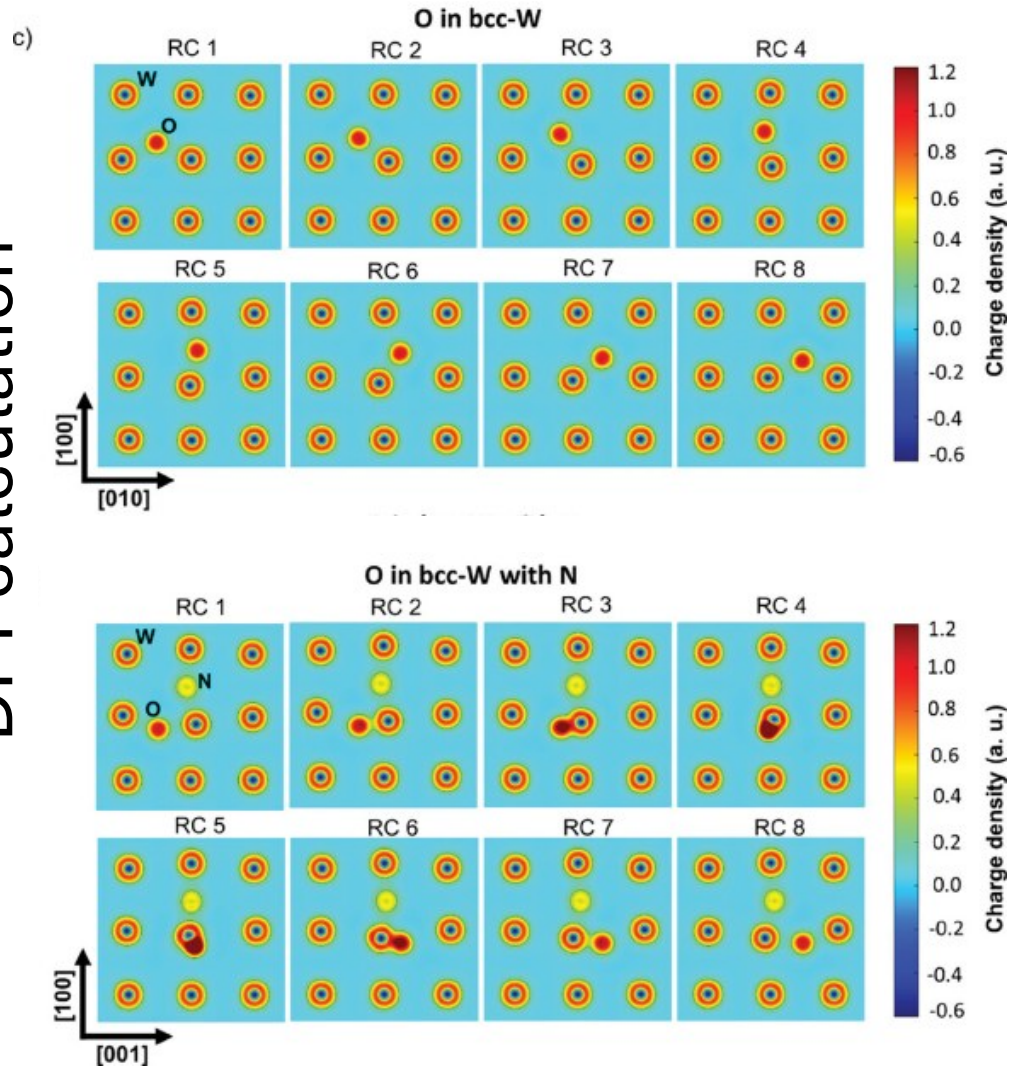
Argon environment



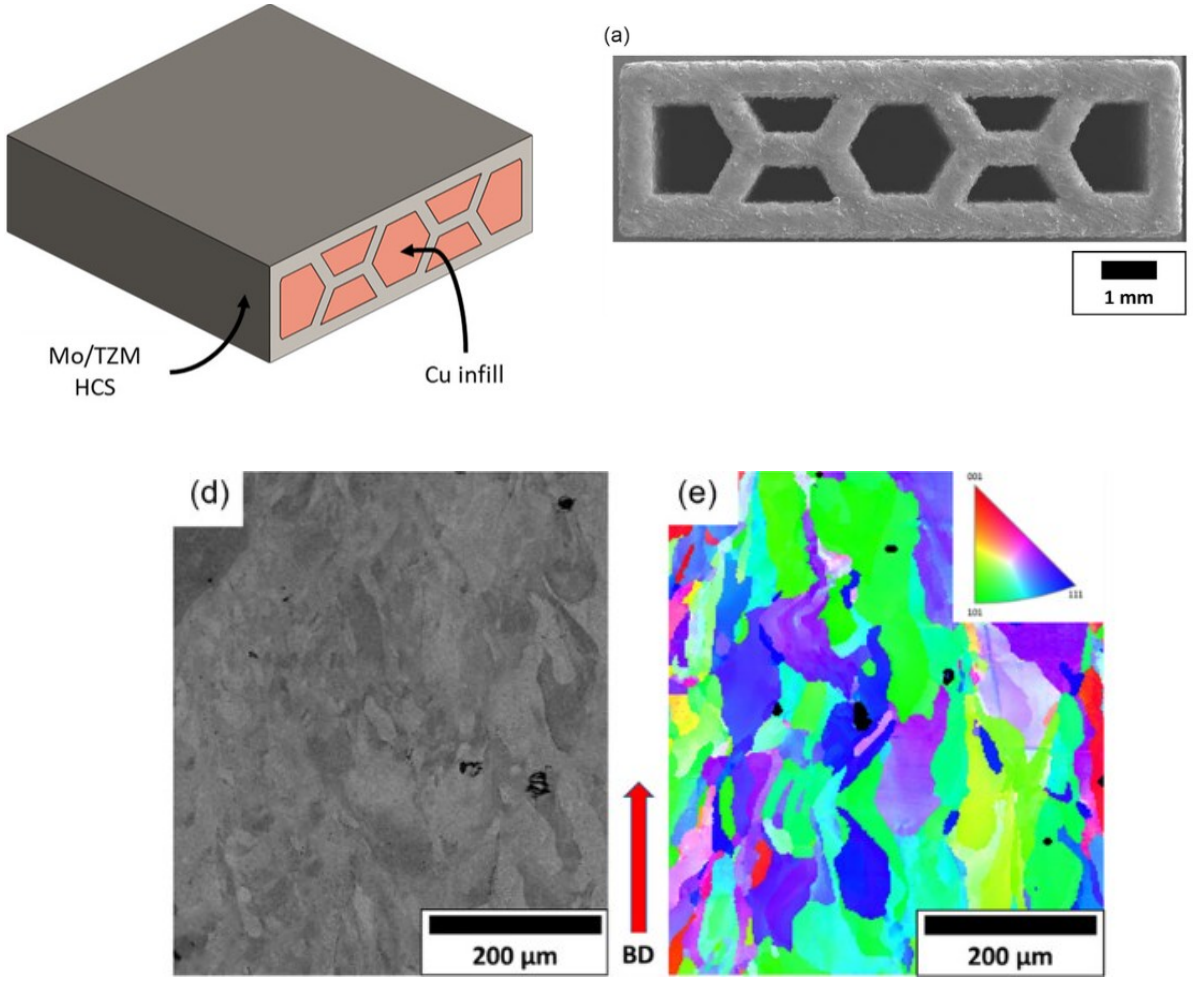
Nitrogen environment

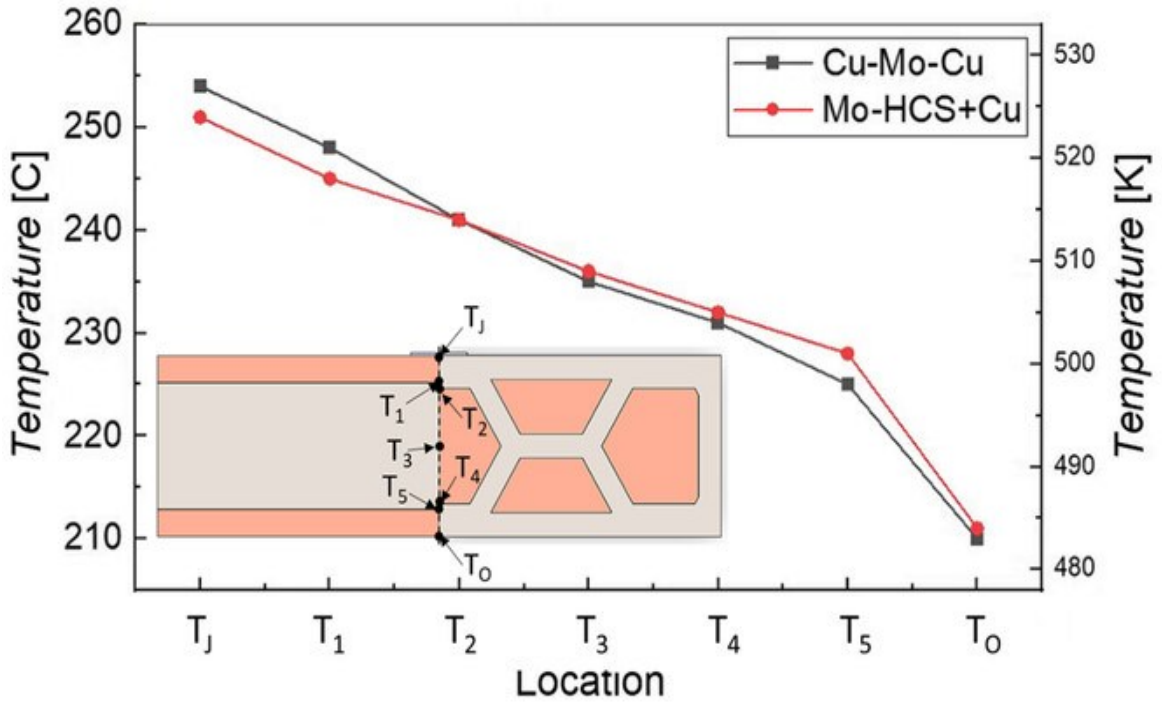


DFT calculation



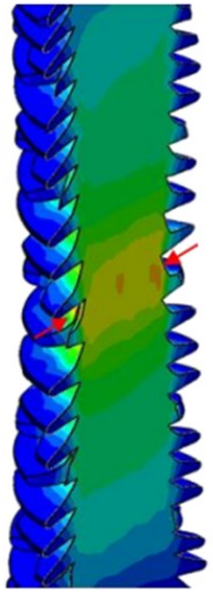
5. Mo and TZM exoskeleton - Heat Sink- fabricated via Laser melting process



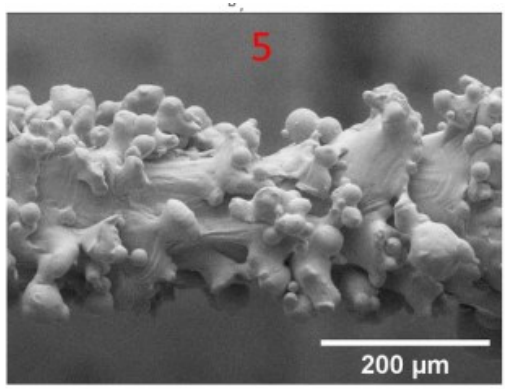


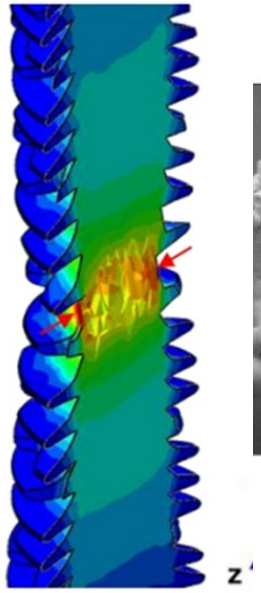
Thermo-mechanical calculation for electron beam additive manufacturing

6. Biomimetic Surface Engineering: Postprocessing and surface texture using Femto Laser Processing

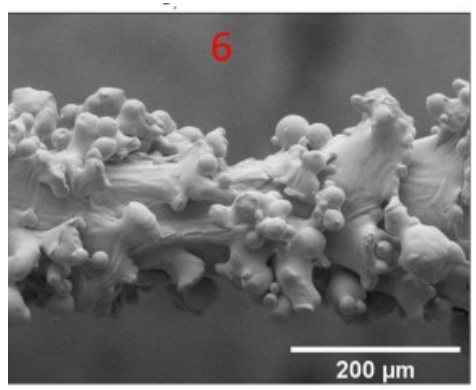


$\varepsilon_{eng,p.} = 0.48$

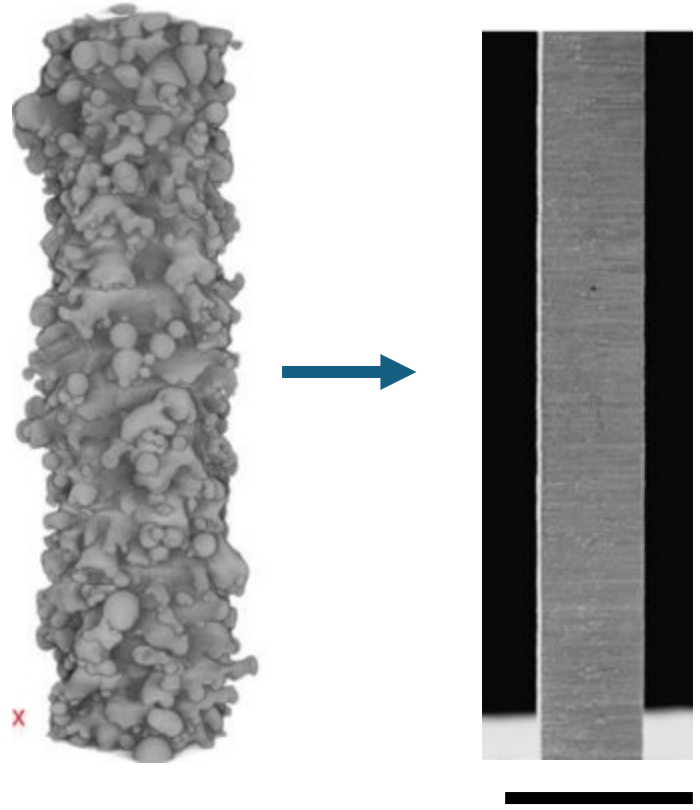




$\varepsilon_{eng,p.} = 0.53$



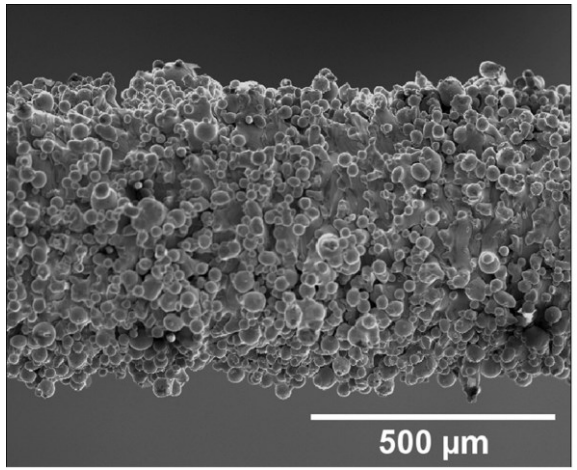
Premature Failure of struts of 250um dia

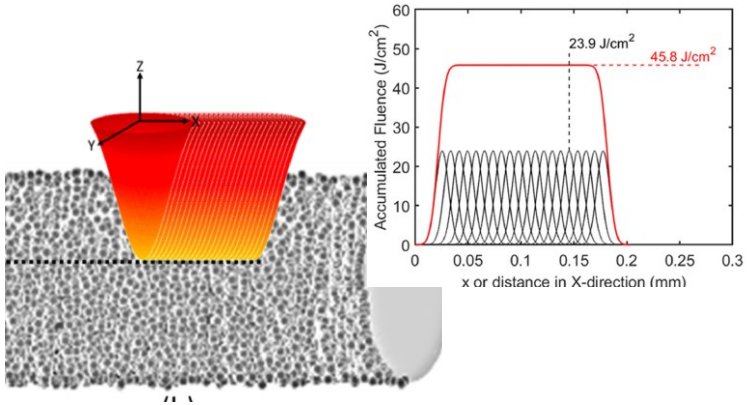


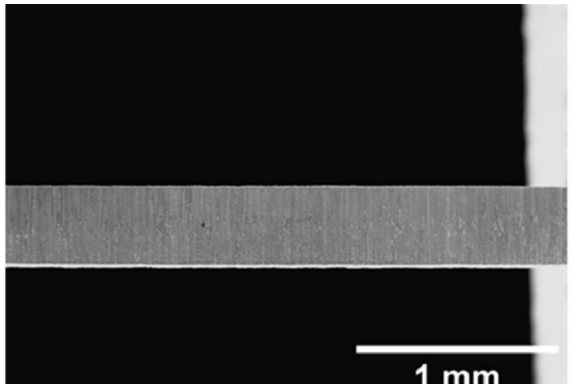
1mm

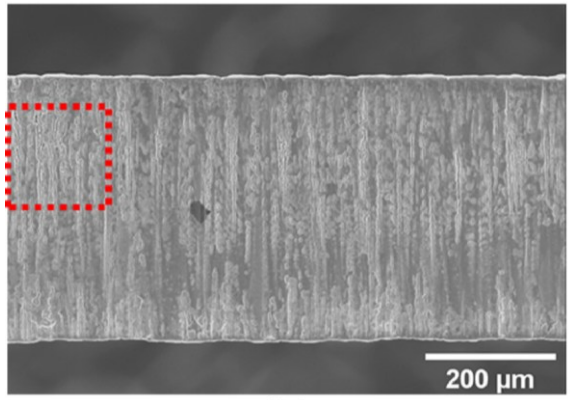
Femto-laser machining

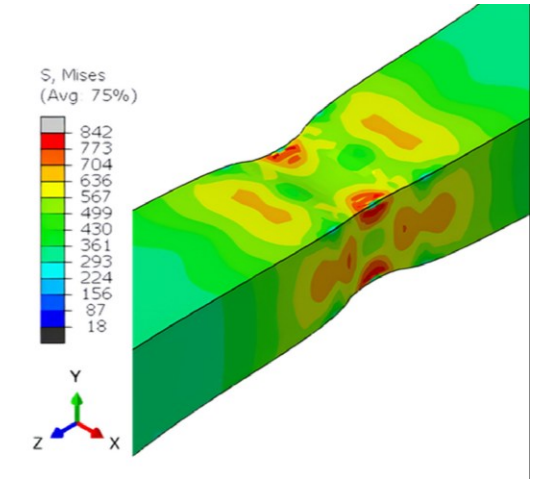
7. Femtosecond laser micromachined specimens: Analyzing surfaces internally linked machined kerfs

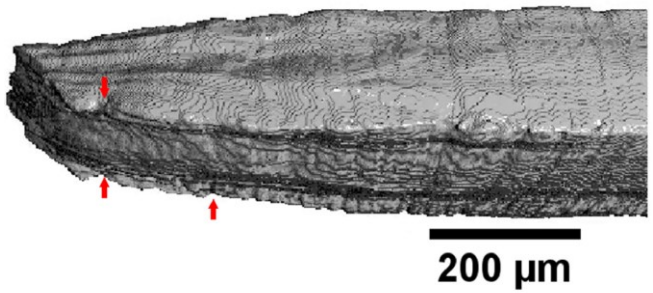






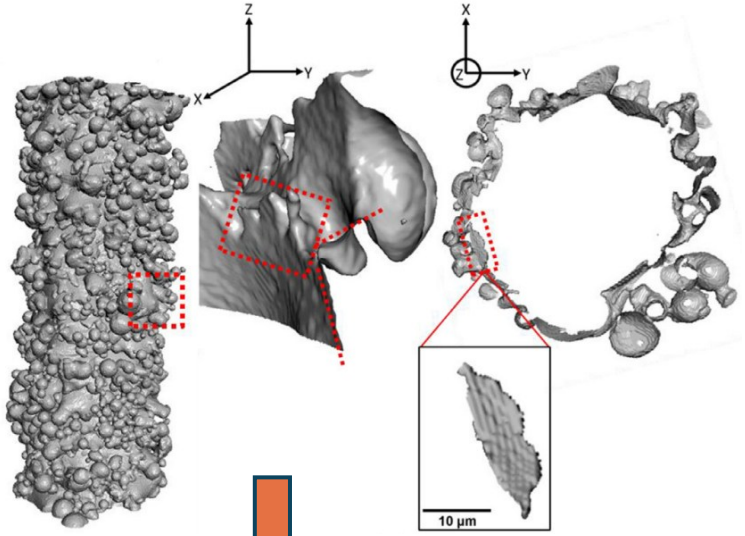


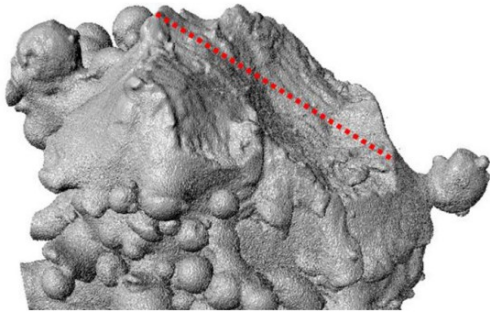


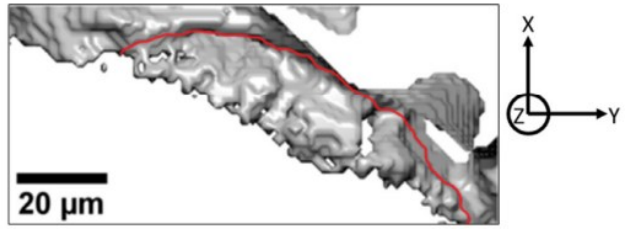


8. Fatigue behavior of SS316L micro-struts fabricated by LPBF

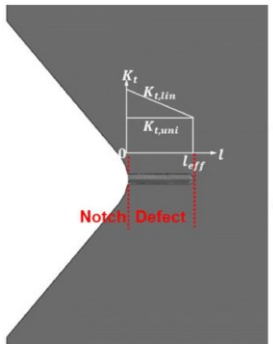
CT data before fatigue testing

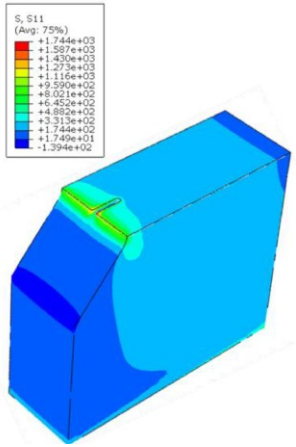


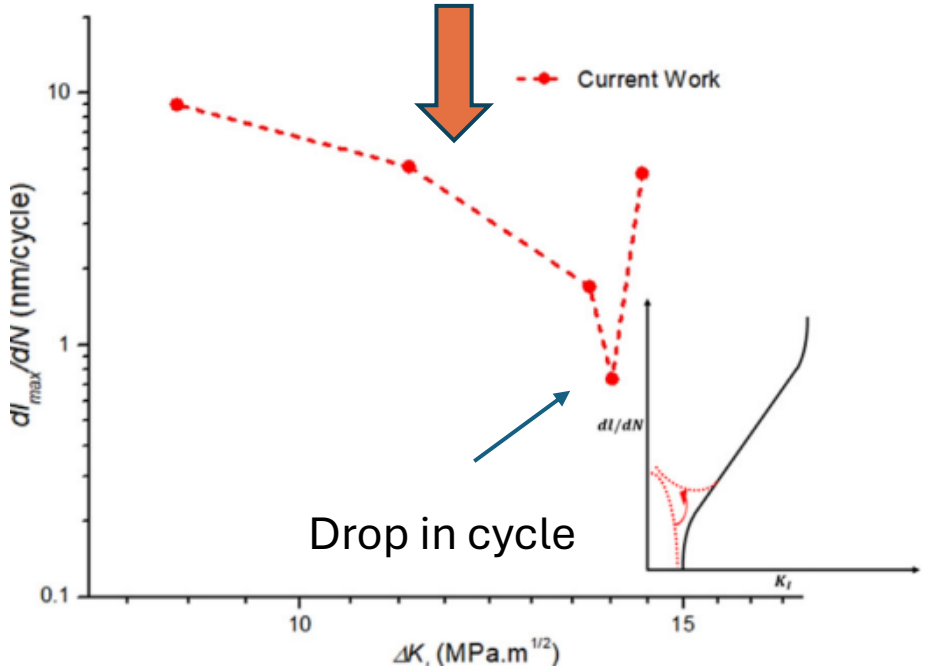




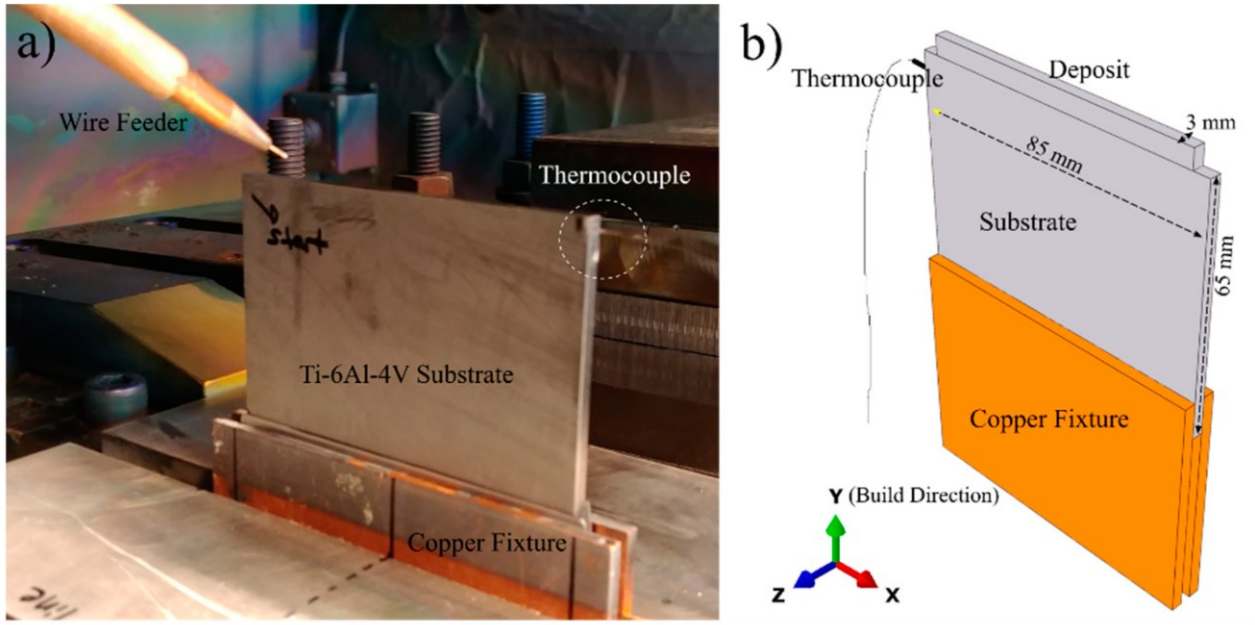
Prediction model for the fatigue based notch sensitivity



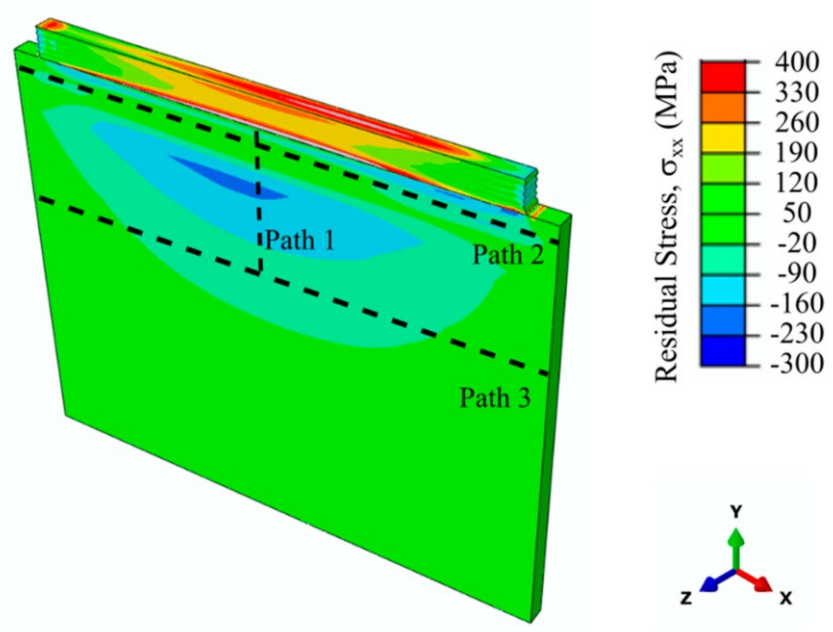




9. National Research of Canada: Wire-Fed Electron Beam Additive Manufacturing



Experimental set-up



Thermo-mechanical calculation for electron beam additive manufacturing

Experiences in machine design, manufacturing, and automation



1. As a Training Professional

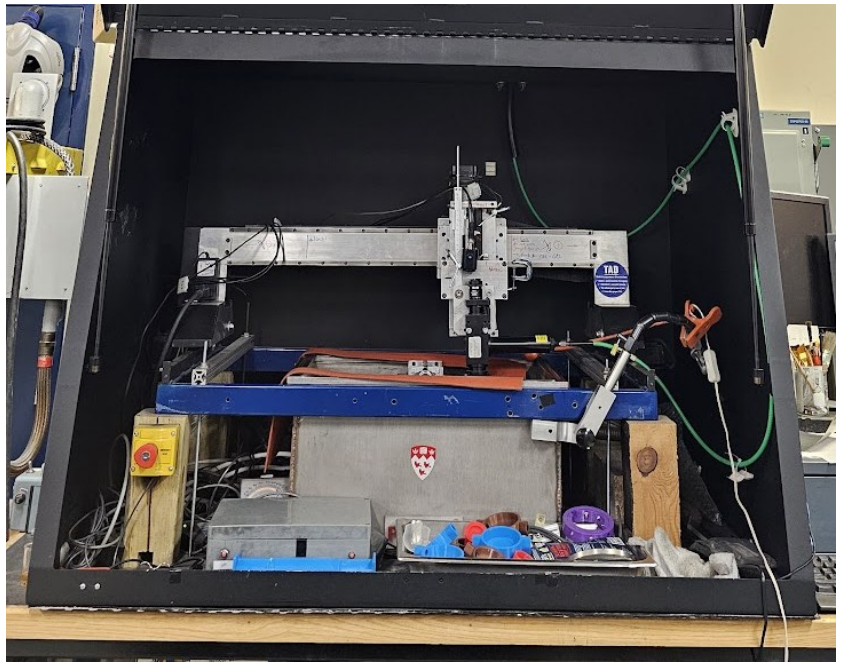


Trained PhD scholars from IIT on Fanuc-weldPro and MasterCAM for integrating laser, TIG, and MIG welding operations in metal additive manufacturing.



Training and educating Stryker engineers on advanced laser physics and case studies for fabricating medical implants using metal additive manufacturing.

2. Integration of laser system for melting powder bed selectively



Laser-based Metal Additive Manufacturing setup

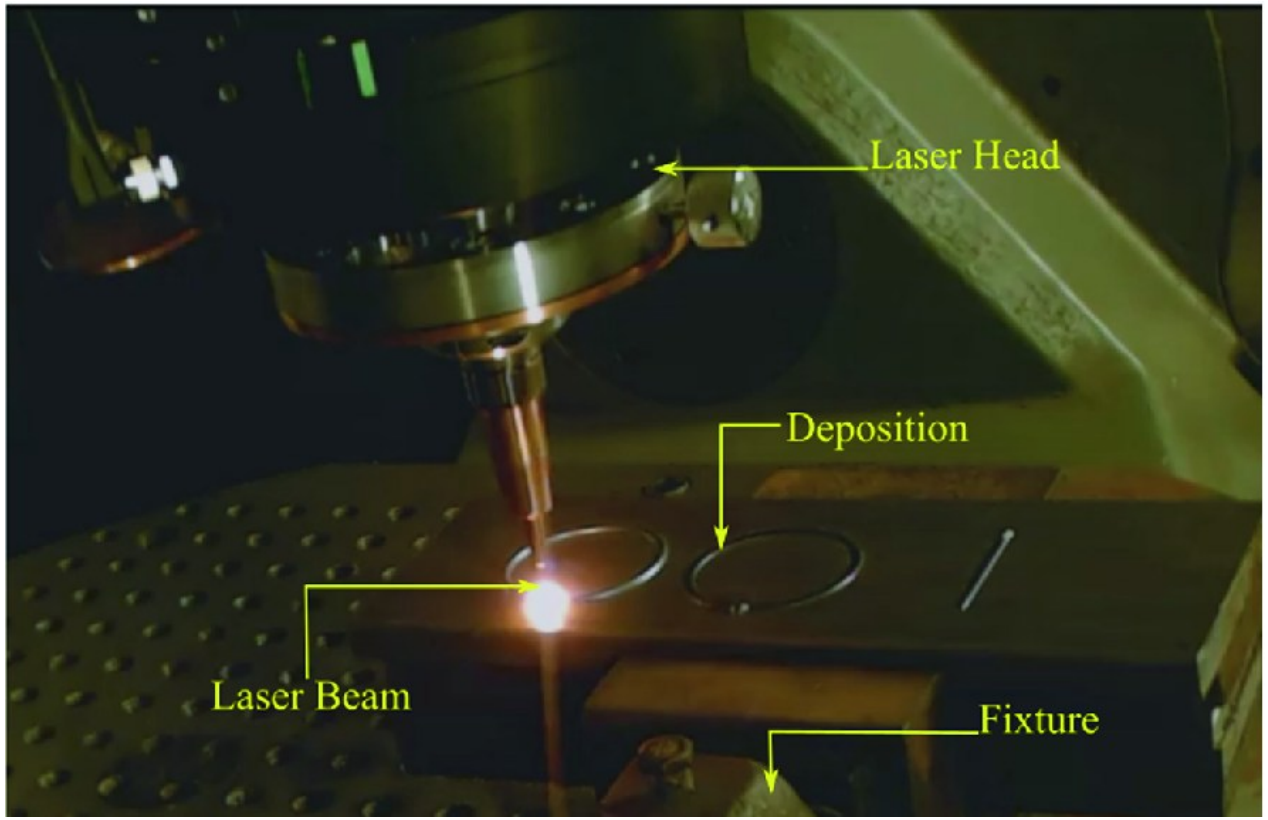


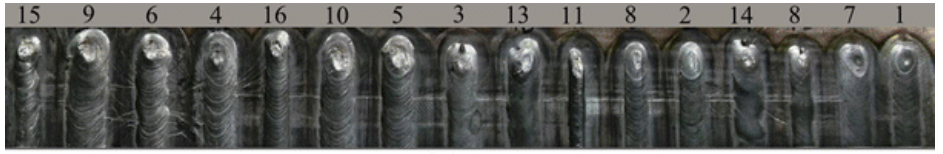
Miyachi laser system

- Assembled and calibrated the Miyachi LW25A laser system, integrating it with a gantry-based X-Y manipulator.
- Leveraged pulse modulation capabilities and conducted caustic analysis for laser profile optimization.
- Work is published in peer-reviewed journals

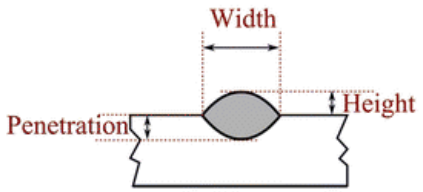
3. Retrofit of Fraunhofer laser head with Hermel CNC machine for wire cladding

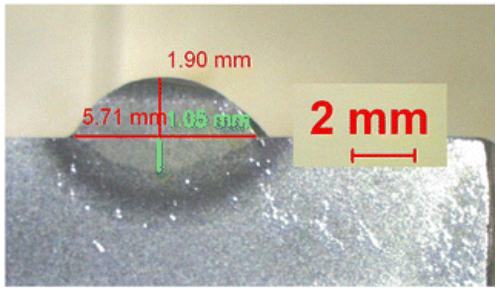
Fraunhofer Laser Head Depositing Mild-Steel Wires

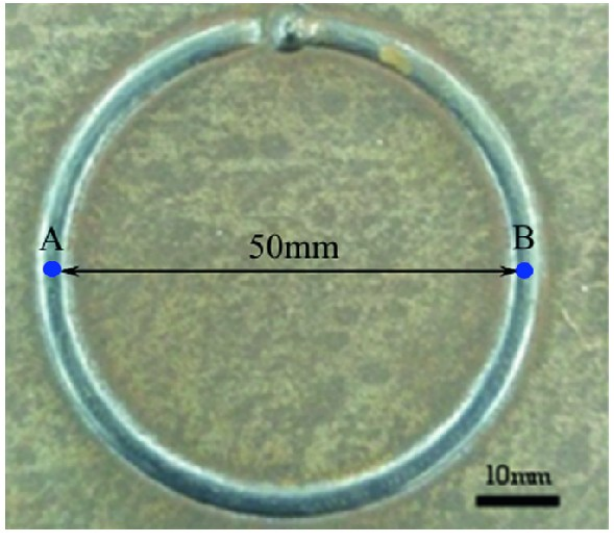




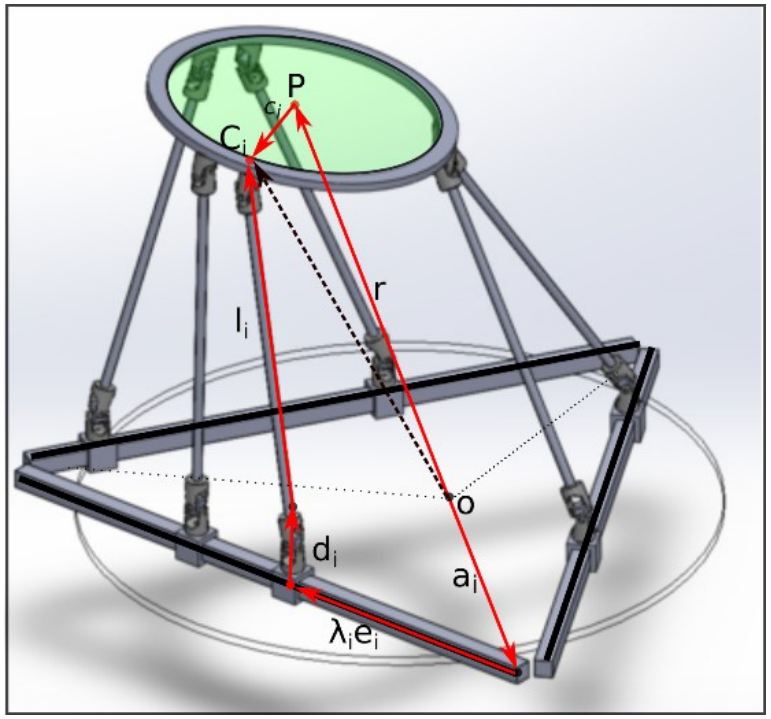
(a)







4. Fabrication and Automation of Parallel Robot for 5-axis movement

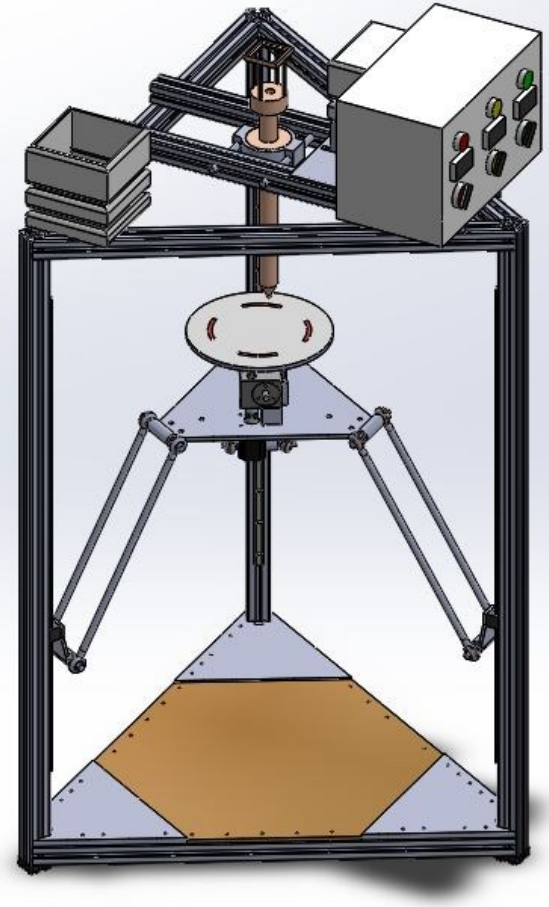


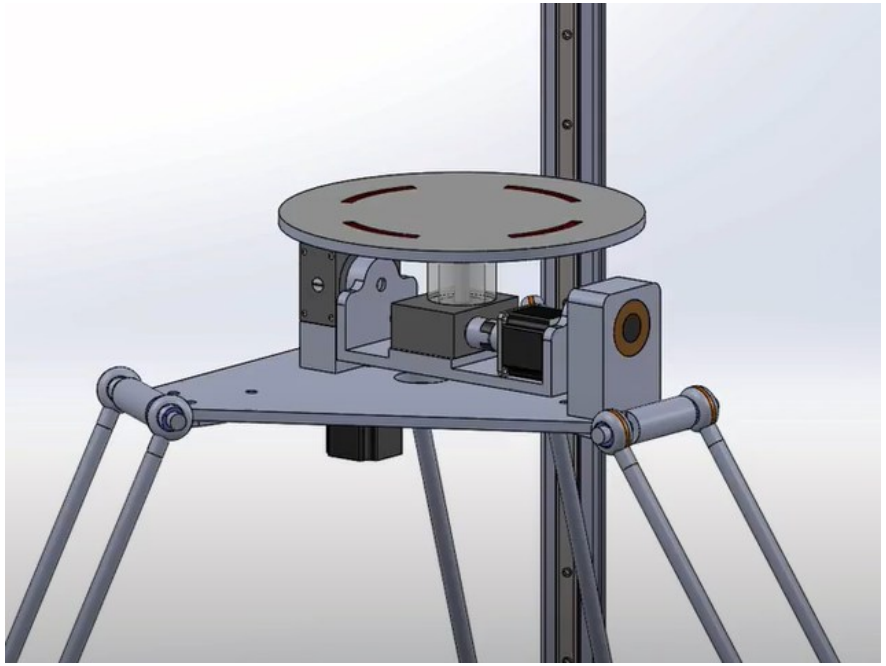
Design and manufacturing
x-y-z manipulator



Link to the Video

5. Fabrication and Automation of Delta Robot for Polymer 3D Printing





Click for the Video Link

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