Project 58-L: Understanding Microstructure Evolution of High Temperature Ni Alloys Across Additive Manufacturing Processes

Semi-annual Spring Meeting

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Project 58-L: Understanding Microstructure Evolution of High Temperature Ni Alloys Across Additive Manufacturing Processes

CANFSA
CENTER FOR ADVANCED NON-FERROUS STRUCTURAL ALLOYS

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- Advisor(s): Jonah Klemm-Toole (Mines)

Project Duration
MS: September 2021 to August 2023

- Problem: The replacement of large structural components in power generation applications often involves long lead times resulting in power plant outages that are expensive and deteriorate the robustness of the energy infrastructure.
- Objective: Understand the high temperature mechanical properties of large scale wire arc additively manufactured (WAAM) alloys to enable rapid production structural components for high temperature applications.
- Benefit: Reduced manufacturing times of replacement components for power generation applications

Recent Progress

- Initial experiment completed on investigating the annealing response of two Ni alloys processed with laser powder bed fusion (LPBF) and WAAM
- It was found that differences in stored energy between LPBF and WAAM had a much greater influence on annealing response than the differences in precipitate stability in IN625 and H282.
- Programs have been developed to build thick sections using the collaborative robot WAAM system

Metrics		
Description	**% Complete**	**Status**
1. Literature review	10%	●
2. Initial annealing experiment on LPBF and WAAM IN625 and H282	50%	●
3. Generate WAAM builds of austenitic stainless steels for long term thermal exposure	5%	●
4. Long term aging experiments to assess microstructure stability	0%	●
5. Creep testing of WAAM builds	0%	●

Poster Outline – Annealing of Ni Alloys Processed with LPBF and WAAM

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Industrial relevance: Additive manufacturing (AM), as a new alternative that can revolutionize how we produce parts and products in many different industries.

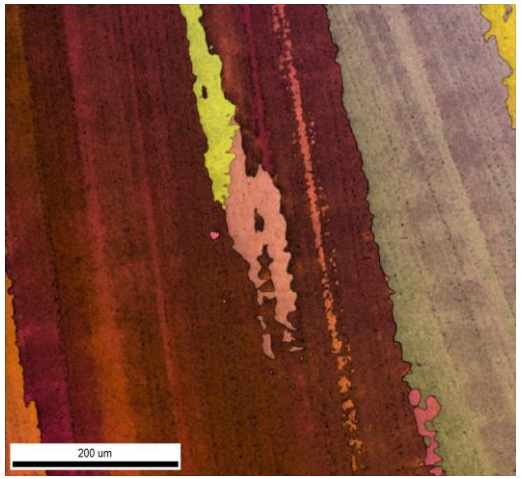
Project overview: We seek to explore and understand the annealing behavior of two Ni based alloys, Inconel 625 (solution strengthened alloy) and Haynes 282 (precipitation hardened), manufactured with WAAM and LPBF.

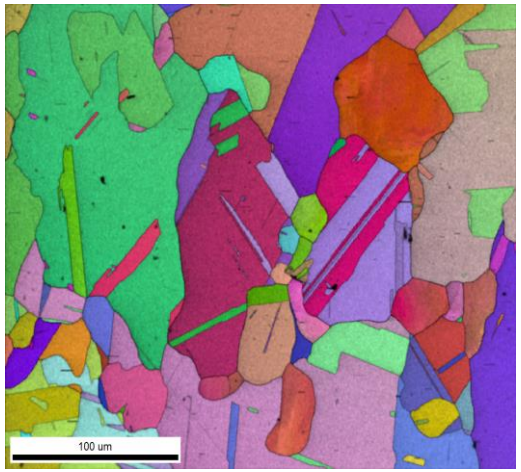
Objective: Understanding the effect of AM process type on the microstructure of Ni based alloys is envisioned to open doors to improve the quality of manufactured components.

Previous Work: There is very little work in the literature evaluating the effects of AM process on annealing behavior of Ni-based alloys.

Experimental plan: Preparation, testing and analysis of IN625 and H282 samples.

- AM Processes: WAAM & LPBF
- Characterization techniques: EBSD & Micro-hardness testing





Thank you!

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