Title: *Efficient Alloy and Process Design for Additive Manufacturable Refractory Alloys*

Research Team:

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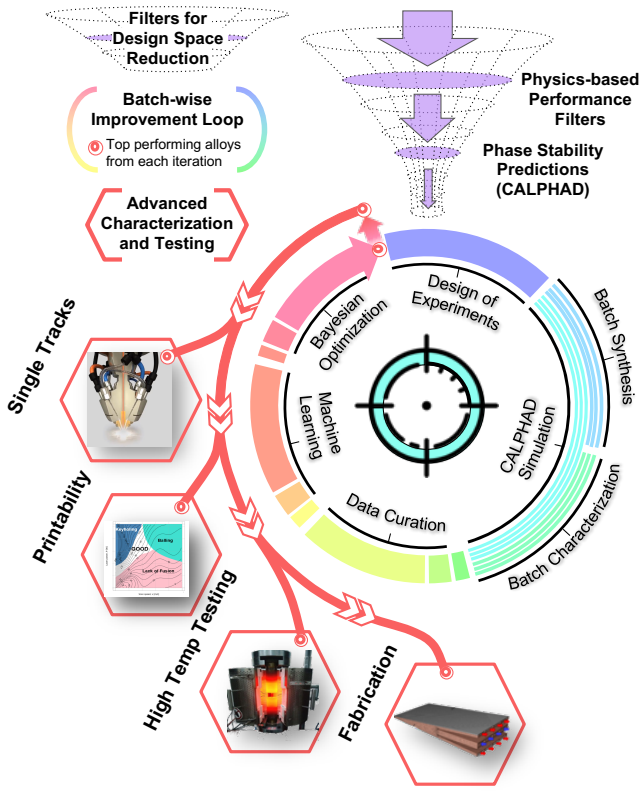
A Batch-wise Integrated Framework for the Alloy+Process Co-design of Additive Manufacturable Refractory Components



Research Objectives

Overall goal: Develop and demonstrate a framework for the co-design of chemistry and processing window for printable, high-performing refractory alloys

Objectives:

a. Identify alloy chemistries satisfying performance (high-temperature yield strength, room temperature ductility) and printability (slow solidification rate, narrow solidification range) requirements.
b. Assess Laser Powder Bed Fusion Additive Manufacturing (AM) process window resulting in fabricated AM parts free of macroscopic defects.
c. Print and characterize (including tensile tests at 2,000^{0}C) test coupons of top performing alloys
d. Design and fabricate aerospace-relevant component capable of operating at high-temperatures

Approach

- Use state of the art (SOA) alloy search sche regions, combining CALPHAD phase stabilit and ML-based property models
- Use beyond SOA approaches to batch Bayesian Optimization of materials in combination with advanced alloy prototyping experimental facilities to discover candidate alloys
- Synergistic combination of SOA physics-based models, machine learning and experiments within an integrated framework to assess printability of top performing alloys
- Fabrication of test coupons and characterization of strength at ultra-high temperatures using SOA facilities
- Design and fabrication of aerospace-relevant parts by synergistic collaboration between Boeing and TAMU

Potential Impact

- Demonstration of accelerated alloy + processing co-design in the refractory alloy space
- Development of new refractory alloys with strengths superior to W-based alloys, lower density and better printability
- Demonstration of ability to fabricate complex AM refractory parts for aerospace applications