ADAPT Monthly Members Meeting
06 March 2019

Attendees:

Member Companies
Karen Buechler (ALD Nanosoultions)
Abby Smeltzer (Ball Aerospace)

Mines
Branden Kappes
Nathan Johnson
Tom Gallmeyer
Behnam Amin-Ahmadi
Zachary Brunson
Sen Liu
Anna DeGraaf

Welcome/Introductions

Announcements

- **Elementum 3D –** Moving into a new space which will improve appearance, spatial design of their headquarters.
- **ALD Solutions –** Looking to begin additive projects and increasing additive capabilities.
- **Ball Aerospace –** Working together with Elementum 3D to build RF purposes for a surface trade study testing different inconel's printed for cost reducing materials.

Presentations

1. Branden Kappes (ADAPT Operations Director)- "Modeling process-structure-property relationships in additively manufactured alloys with machine learning and materials informatics"

2. Behnam Amin-Ahmadi (Research Assistant Professor)- "Development of superelastic nickel-titanium-hafnium alloys for additive manufacturing"
    a. NiTiHf is a good candidate for 3D printing: Precipitation strengthening in NiTiHf increases the strength of the alloy without need for initial cold working
    b. Initial 300C for 12H and 550C for 30 min pre-aging after solution treatment increases the reversible strain in both NiTiHf (6HF and 8HF) shape memory alloys.

c. Aging treatment of both compositions of NiTiHf causes decreasing the required stress for martensitic transformation and increasing the reversible strain until overaged condition is reached.
d. At the same aging conditions Ni-41.7Ti-8Hf shows better superelastic behavior than the Ni-43.7Ti-6Hf which can be due to precipitate morphology in 8Hf sample.

3. Sen Liu (PhD Student) - "Comprehensive quality assurance of additive manufactured Ti-6Al-4V by learning from prior studies"

    a. A learning framework systematically gather previous studies and extract information to accelerate new experiments design and reduce costs
    b. Naïve Bayes model is developed to build AMTi64 process-property correlations
    c. Great capability to preform density and microhardness property prediction
    d. Optimize process the first time using this framework shows great flexibility.

4. Thomas Gallmeyer (PhD Student) - "Investigation of post-processing heat treatments on the mechanical and Microstructural properties of Inconel 718 manufactured by laser powder bed fusion"

    a. Optimizing existing heat treatment for AM is critical as standard heat treatment is not ideal for AM-IN718
    b. Direct aging can provide greater mechanical strengths due to the coexistence of nanoprecipitation and dislocation cells
    c. Correcting for residual microsegregation and Laves phase, while preserving dislocation cells, has the ability to further improve mechanical response on AM IN718

5. Zachery Brunson (PhD Student)- "A new perspective on visualizing the elastic limit and the necessity of 6D limit hyper surfaces"
    a. 3D printing materials can introduce anisotrophy
    b. In anisotropic materials, stress should be treated as 6D object therefore visualization in 6D is necessary
    c. In anisotropic materials, errors exist when reducing stress space to 3D, although convexity is unaffected but calibration is also affected.

Next Members Meeting
Wednesday, April 10, 2018
1:30–3:30 (MST): Starzer Welcome Center, 1812 Illinois St., Golden, CO 80401

Agenda: Guest Speaker: Nik Harabe will provide an overview of NIST activities and objectives in metals AM research.