LIGHTWEIGHT INNOVATIONS FOR TOMORROW

Operated by *ALMMII*

Manufacturing USA Lightweight Metals Institute

Presentation to: HPC4Mfg Industry Engagement Day

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Lightweight Innovations For Tomorrow Institute Mission

- Accelerate the development and application of innovative ***lightweight metal production and component manufacturing*** technologies to benefit the US transportation, aerospace and defense market sectors
- Deliver high value advanced alloy processing technologies that reduce the weight of machines that move people and goods on land, sea and air

LIFT Technology Scope

- Priority metal classes and their alloys:
  - Advanced High-Strength Steels, Titanium, Aluminum, and Magnesium
- Technology development grouped into six pillars:
  - Melt Processing
  - Powder Processing
  - Thermo-mechanical Processing
  - Low-cost Agile Tooling
  - Coatings
  - Joining and Assembly
- Coupled with cross-cutting themes:
  - Integrated Computational Materials Engineering (ICME)
  - Validation & Certification
  - Design
  - Life-cycle Analysis
  - Cost & Supply Chain Modeling
  - Corrosion
  - Blast & Ballistics

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LIFT TMP-R1-3b
Assured Properties in Al-Li Forgings

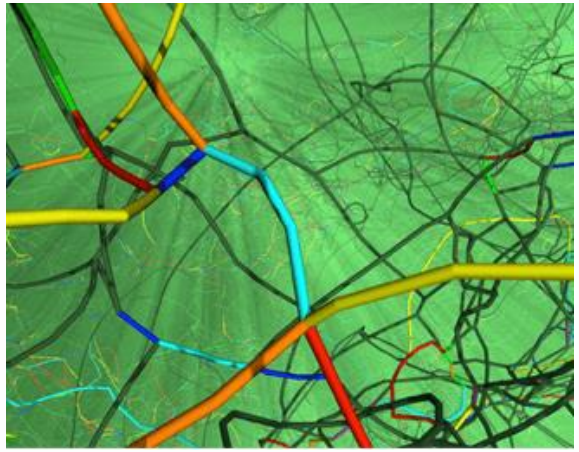
- Objective: Accurately predict the performance of aluminum-lithium alloys in formed parts by developing advanced computer simulations.
- Industry Partners:
  - United Technologies Research Center
  - Lockheed Martin
- Research Partners:
  - University of Michigan
  - Case Western Reserve University
  - The Ohio State University
  - Southwest Research Institute

Replace make and break with accurate computational simulations

High Performance Computing for Manufacturing Project

HPC 4 MANUFACTURING

- Simulate the interaction and evolution of dislocations with the primary precipitates to predict the strength of proposed Al-Li alloys
- Includes full elastic interactions between dislocations, the evolution of dislocation networks, and the treatment of the precipitates as finite nanoscale objects locally interacting with the dislocations
- Execute large-scale dislocation dynamics simulations on supercomputing facilities at LLNL to investigate the parameter space of the precipitate microstructure to provide sufficient statistical information



Dislocation dynamics using LLNL's ParaDiS capability

Results & Benefits

- Development of new mobility law for Al and Al-Li alloys
- Large-scale simulations of aluminum with periodic arrays of ellipsoidal lithium (and other) precipitates show how to develop higher strength
- New lightweight high melting-point Al-Li alloys will allow us to reduce the weight of aircraft engine turbine blades
- Anticipated weight saving from these new blades is 20% - 25%
- Total weight saving per engine is about 75 lbs
- Total amount of fuel saving 13.5 million gallons per year
- Expected savings are $26M per year

A Manufacturing USA Institute

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