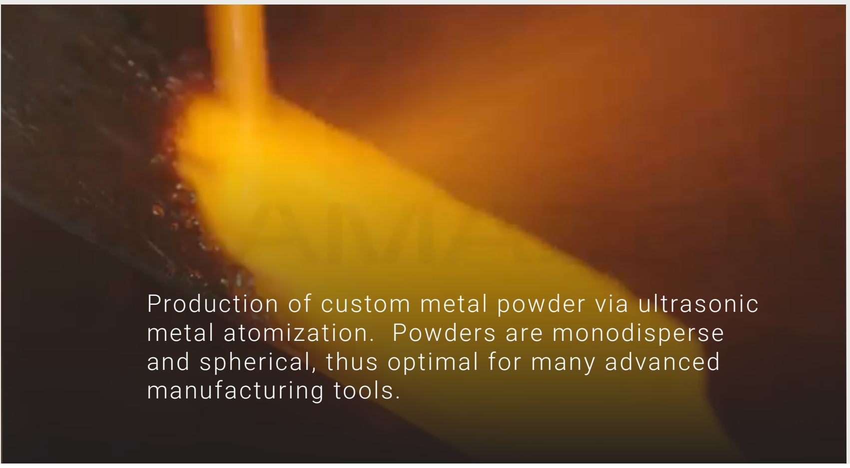
METALLIC

ALLOY DESIGN & ADVANCED MANUFACTURING (ADAM)

The ADAM Center deploys new alloy production and advanced manufacturing processes that can produce critical materials–enabled parts with greater efficiency and improved properties.

WHY IS ADAM IMPORTANT?

- Scaling from advanced manufacturing prototypes to high-throughput production enables steady supply chains of critical materials, such as rare earth elements, graphite, battery materials, and others.
- The new approaches used in alloy design and advanced manufacturing — such as optimized thermal treatments, controlled atmospheres, and quality controls — improve the properties of critical material-containing components.
- Adoption of new advanced manufacturing approaches can be increased through the creation of standards and qualification pathways.



Production of custom metal powder via ultrasonic metal atomization. Powders are monodisperse and spherical, thus optimal for many advanced manufacturing tools.

WHAT ROLE AND SERVICES DOES THE ADAM CENTER PROVIDE?

The ADAM Center is focused on developing new alloys and advanced manufacturing techniques for innovations in critical material–containing components. Activities are grouped in four categories:

Solid Phase Processing
Improve the properties of critical material alloys by maturing new technologies that can create desired microstructures

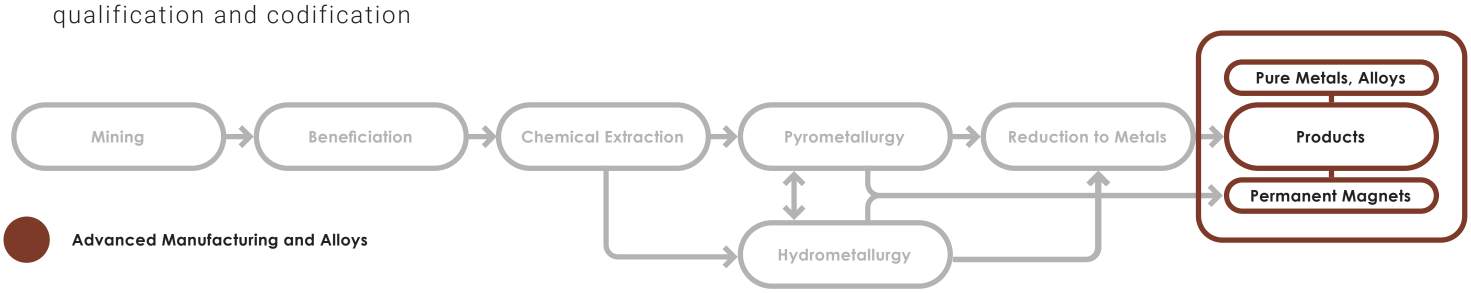
Advanced Alloy Production
Validate predictions for new compositions or processing conditions using in situ probes to optimize functional properties

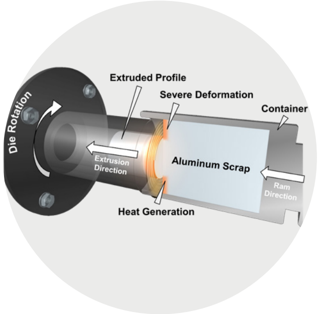
Semiconductor Testbed
Develop a thin film semiconductor autonomous processing capability, accelerating “lab-to-fab” technologies

Advanced Topology Prototyping
Optimize and scale structures enabled by additive manufacturing to improve critical material efficiency and part performance

OUR GOAL IS TO MATURE, DEMONSTRATE, AND DE-RISK ADVANCED MANUFACTURING APPROACHES AND NEW ALLOY DESIGNS BY:

- Working with stakeholders to develop and validate advanced manufacturing and alloy design methods
- Rapidly demonstrating improved alloy design and advanced manufacturing for critical-material-containing components
- Demonstrating scaled-up methods to de-risk industrial adoption and generating process data needed for qualification and codification



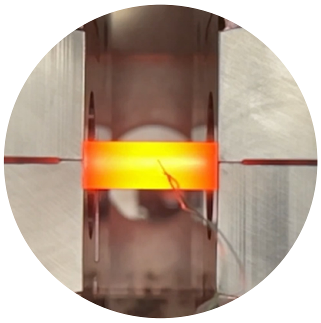


SOLID PHASE PROCESSING

Capabilities
Shear-Assisted Processing and Extrusion (ShAPE), hot-roll processing, extensive rolling mills, extrusion, hot forging capabilities

Processing Scale
Current: 0.5–1000 kilograms (kg) as batch processing depending on specific capability | Future: Quasi-continuous processing

Outcomes
Advanced manufacturing approaches to produce alloys with improved properties through microstructure refinement



ADVANCED ALLOY PRODUCTION

Capabilities
Validation of new production methods and alloys through advanced high-temperature characterization (e.g., ϵ, ρ, CTE, mechanicals) under controlled atmospheres

Processing Scale
Currently 0.1–10 kg at up to 1,800 °C, with additional tools to be added and characterization to 2,200+ °C

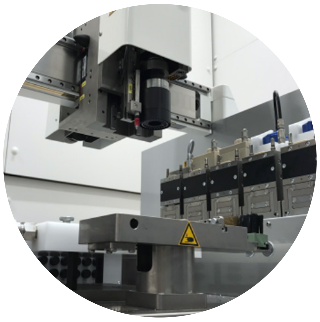
Outcomes
Define key process parameters to optimize advanced manufacturing of critical materials–enabled alloys

SEMICONDUCTOR TESTBED

Capabilities
In situ reactor diagnostics to transfer "lab-to-fab" alternative semiconductor materials and automated deposition with feedbacked process monitoring

Processing Scale
Current: 2–3" wafers with high-throughput processes | Future: 6" wafers with high-throughput processes

Outcomes
Process parameter optimization and characterization to accelerate the maturation and deployment of next-generation semiconductors



ADVANCED TOPOLOGY PROTOTYPING

Capabilities
AI–driven smart coating; 2D/3D printing; nanoparticle (NP) synthesis for coatings; modeling, design, and simulation tools

Processing Scale
Current: Coating 5–10 meters per minute (m/min) with in-line quality control; 5 grams per hour (g/hr) NP production | Future: 30-millimeter coating at 40 m/min + 20 g/hr NP production

Outcomes
Architecture-driven material prototyping and functional integration to enhance performance, durability, and manufacturability across emerging technologies

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