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**TITLE: Ultrasonic Powder Atomization for Alloy Development**

**RELATED ROAD-MAPPING DESIGNATION ID#: AM75**

**SUPPORTIVE INDUSTRY:** ATI

**PROJECT TYPE:** General Project

**PROBLEM STATEMENT (What Are We Trying to Solve?):**

The main difference in this approach is adopting a new lens for alloy composition selection. In conventional manufacturing processes such as casting and forming, alloy design is constrained by process limitations. For forming, compositions must be optimized for deformability and work hardening, while for casting they are restricted by mold design, shrinkage, and susceptibility to solidification cracking. These constraints significantly limit the compositional space that can be explored.

Refractory Nb-based alloys have very high melting points and excellent strength at elevated temperatures, making them valuable for aerospace, energy, and nuclear applications. However, developing these alloys is slow and expensive because of the complex relationships between composition, processing, and properties. It is key that the future of additive manufacturing builds are not limited by development of alloys. This is especially true for Nb-based alloys. Such research could impact industry such as aerospace and energy.

**PROJECT DESCRIPTION:**

To address this challenge, this project uses an Integrated Computational Materials Engineering (ICME) framework coupled with artificial intelligence (AI) to accelerate the design and optimization of Nb-based alloys produced through powder atomization and additive manufacturing. The approach will also provide a transferable method applicable to other refractory and medium-entropy alloys.

This new framework focuses on selecting and modifying alloy compositions that are inherently well suited for additive manufacturing (AM), rather than for conventional processes. By leveraging available materials databases together with ICME and AI/ML tools, we can systematically explore and identify compositions that would be difficult or impossible to discover through traditional trial-and-error approaches.

This strategy enables data-driven alloy design that supports cost reduction, improves manufacturability, strengthens supply-chain resilience, and enhances the performance of AM-

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produced components. This is a critical first step in working with industry partners to obtain feedback, generate preliminary results, and build a strong foundation for large-scale federal funding opportunities. In this project the researcher would collaborate directly with OMIC as well as the companies such as ATI and Boeing.

The goal is to identify the limitations of current high-temperature alloys, such as inadequate oxidation resistance, limited ductility, and high cost, and to develop design strategies that reduce cost and lead time while improving critical properties. Case studies of existing alloys used in extreme environments will be systematically evaluated to highlight their shortcomings and guide the design of new alloy compositions and manufacturing processes that simultaneously enhance performance, manufacturability, and economic viability.

This project should cover the following tasks (but not restricted to):

- Collaborate with OMIC and industry partners to identify high-temperature alloys that can be redesigned for additive manufacturing (AM) processes.
- Identify the major limitations and challenges of conventional manufacturing and the potential benefits of transitioning to AM.
- Fabricate components using conventional alloy compositions through AM as baseline cases.
- Evaluate the microstructure and properties of AM parts and benchmark them against conventionally manufactured components.
- Leverage ICME and ML databases to modify conventional alloy designs for optimal performance in AM.
- Atomize the newly designed compositions at OMIC to produce tailored powder feedstock.
- Use the new feedstock in AM processes to fabricate test components.

**Identify Related OMIC R&D Resources:** Proposing researchers should use their best judgment in deciding on the optimal resources for the research. To further aid in this decision, the OMIC staff has taken the initiative to best identify on-site resources (machines, equipment, and staff) that may relate to the scope of this research. Please recognize that researchers are not limited to these resources.

- Machines and equipment at OMIC can be reviewed at:  
<http://omic.us/applied-research/additive/>  
<http://omic.us/applied-research/subtractive/>  
<http://omic.us/applied-research/materials/>  
<http://omic.us/applied-research/robotics/>

# OMIC R&D TECHNOLOGY BOARD

## CONCEPTUAL ABSTRACT



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<http://omic.us/applied-research/inspection/>

- OMIC Staff or SMEs  
<http://omic.us/applied-research/>

### PROJECT DELIVERABLES:

- Final report
- Final presentation

**SPECIAL NOTE:** It should be recognized that this Conceptual Abstract is written based on comments collected during OMIC R&D Road-mapping workshop and based on industries' need for applied research. However, researchers as SMEs are encouraged to lend specific technical feedback to further refine the Project Description and/or Project Outcomes. The proposed researcher may do so either directly to OMIC R&D, or in the submitting proposal.

**UTILIZATION OF OMIC RESOURCES:** Researchers are encouraged to utilize the capital and personnel resources available on the OMIC R&D campus in their proposals. Use of OMIC time and machines should be included in the Proposal funding request. If use of OMIC resources are not identified in a proposal and are requested during the project, sponsor will be responsible for requesting a costed project amendment from the Tech Board.

**PROJECT UPDATE EXPECTATIONS:** Researchers are required to have monthly update discussion with OMIC R&D to provide a summary update on project status. This is done by way of a user-friendly format known as the OMIC 6-Block update. Depending on the scope of the project, OMIC R&D's industry Tech Board representatives are often interested in periodic project updates, and even in project participation. Researchers are required to communicate with supportive industry and facilitate communications as required.

**ADDITIONAL COMMITMENTS TO FACTOR:** Researchers may be asked to present their final project at an OMIC R&D biennial Technology Exchange Symposium. This symposium is an in-person event, held at the OMIC R&D campus in Scappoose Oregon. The Symposium is held in the spring, and researchers should factor in their availability when bidding on projects.

Researchers may be invited to participate in OMIC R&D's marketing efforts that showcase the working history of the project.

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**PROJECT DURATION:** It's OMIC R&D's strong preference that duration of a General Project aligns with the academic calendar cycle (July 2026 to June 2027). It is preferred that the project be completed by June 2027. Researchers are encouraged to factor in variables such as contracting, student hiring (if needed), procurement, holidays, and travel. It has been OMIC R&D's experience that a project's useful working duration is typically 9 to 10 months. Researchers are also encouraged to give feedback, and to adjust the scope of work to best fit this preferred timeframe. Additionally, it is reasonable to even recommend phasing breakdowns to the project. In some unique circumstances, if the project is to take significantly longer than the duration of the academic year, this reasoning should be explicitly explained in the proposal.

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