

Request for White Paper

Hypersonic Thermal Research and Material Acceleration - Ceramics

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October 14, 2021

Program Abstract

The program funded under this effort has the goal of continuing the development of ICME (Integrated Computational Materials Engineering) models for materials suitable for hypersonic vehicles. LIFT has invested in and is developing a significant ICME model database for hypersonic materials via team projects. LIFT will print metallics used in hypersonic vehicles via a laser powder bed fusion 3D printer and then test them through various heat and stress/strain cycles to determine “real world” material properties. Materials to include alloys such as Inconel X-750, Ti-6242, and intermetallic Ti-Al alloys. Material properties will then be compared and contrasted to the ICME models. Deviations will be used to fine-tune models to provide accurate results in future application usage. These models will be loaded into a materials database accessible by suppliers and manufacturers to the Army, Air Force, and Navy. Further development and optimization of the ICME capability will enable faster design and higher-quality manufacturing. Focusing this capability on DoD systems and components will bring new tools to the warfighter at greater speed and lower cost.

This program will define opportunities for mechanical property optimization of metallic alloys used in hypersonic vehicles. ICME models that accurately predict the performance of new metallic alloys and ceramic/CMC materials will be created. Manufacturing supply chain(s) for new metallic alloy powders will be established. The mechanical properties predicted through ICME models will be correlated through real-world testing. Disparate metallic alloys will be joined through solid-state joining techniques. The materials database will be augmented with performance results of new alloys and Ceramic/CMC's.



Period of Performance: May 2021 through December 2023

Requested Services – Statement of Work

ICME Toolchain for Ceramics/CMCs

- Develop an ICME toolchain for additive manufacturing (AM) of relevant ceramics/CMCs for hypersonic applications such as a skin or leading edge. Toolchain to include material discovery-chemistry-processing-structure-properties-performance links to enable prediction of ceramic/CMC performance from starting materials. Toolsets to be fully integrated as state of the art allows. **Completion: September 2022**
- Proof of concept toolchain validation including but not limited to microstructure, mechanical properties, and hypersonic performance. Comparison to simulation toolchain results. Recommendations to be provided in a written report for toolchain improvements and developments needed to advance the state of the art. **Completion: September 2023**
- Collaborate with LIFT and LIFT ecosystem partners to be disclosed upon full execution of mNDA to develop LIFT ecosystem partner toolsets for ceramic/CMC ICME applications. **Completion: September 2023**

RASIC Chart

R – Responsible, A – Approver, S – Supporting, I – Informed, C - Consulted

Task	LIFT	Sub-Award Project Lead
<i>Develop ICME Toolchain</i>	A	R
<i>Toolchain validation</i>	A	R
<i>Develop Ecosystem Partner Toolsets</i>	R	C

Expectation of a LIFT Project Partner

- Open to all LIFT members
 - All project consortium members must be a LIFT member in good standing for award
 - Non-members may submit white papers but must join membership as appropriate
- Regular communications/summaries to be provided by the partner, including:
 - Weekly review updates
 - Quarterly reports
 - Final Report
- Demonstration of International Traffic in Arms Regulations (ITAR) Compliance
- Development research is expected to be accomplished internally, without the use of subcontractors



Deliverables

- Financial Plan
- Timing Plan
- Resource plan

Note: Responding to this Request for White Paper for services does not require the provider to be able to support the entire request. Should there be aspects that cannot be supported, simply note those on the white paper.

Submission Due Date: **November 5, 2021**

Submission Portal: <https://lift.technology/project-calls/>

Contact Information

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