

Statement of Work (SOW)

Title: Development of Zirconium Carbide and Superior Ceramics for Nuclear Applications

Objectives: Develop Zirconium Carbide (ZrC) composite test samples using Field Assisted Sintering technology (FAST) for hydrogen corrosion tests.

Background: ZrC belong to the class of **Ultra-High Temperature Ceramics (UHTCs)** and **Ceramic Matrix Composites (CMCs)**. These represent a transformative opportunity to replace traditional metallic reactor components with materials capable of withstanding extreme radiation and temperatures exceeding 1500°C. High temperature ceramics such as zirconium carbide are uniquely stable at extreme conditions, such as high radiation and corrosive environments associated with nuclear systems. This concept aligns with the [Ignition Initiative](#) by shifting lunar technology from exploration-based prototypes to scalable, permanent infrastructure required for **MoonBase** oxygen and water ice production. Beyond the lunar surface, these low-density, high-stability ceramics address the "mass gap" in space architecture, offering a competitive advantage for **Commercial LEO** applications like nuclear thermal propulsion and private space stations. Ultimately, this focus establishes Langley as a leader in managing materials for extreme environments, bridging a vital gap in current nuclear databases and ensuring the safety and efficiency of future space power systems.

Work Plan: The development of ZrC is envisioned in three phases. Phase 1 is the seed phase in which test samples will be developed and tested for hydrogen corrosion. The funding approved for Phase 1 is [REDACTED]. Based on the hydrogen corrosion test results, follow-on phases will be funded for further refinements in FAST processes and optimization of physical characteristics. The workplan for this Phase 1 effort consists of the following task:

Task 1.1: Develop initial Field-Assisted Sintering Technology (FAST) parameters for optimal densification of zirconium carbide at the target specimen coupon geometry (e.g., 40 mm OD x 5 mm discs) appropriate for nuclear-relevant NASA hydrogen corrosion testing. Zirconium carbide powder will be procured by the vendor.

Task 1.2: Press 10 discs of zirconium carbide of diameters according to processing and coupon geometries developed in Task 1.1 via FAST along with test characteristics.

Deliverables: Package and ship 10 discs produced from Task 1.2 to NASA for hydrogen corrosion and other relevant testing.

Duration: The duration of the seed Phase 1 is 3 months.