Materials Genome Initiative (MGI) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)

ANTICIPATED BENEFITS

To NASA funded missions:

Computational materials tools will be developed in close collaboration with existing projects in STMD, GCD, and ARMD. These tools will be infused directly to improve manufacturing and insure accelerated insertion of new materials. For the SLS project, computational tools will focus on reducing manufacturing variability, and part certification to reduce cost and time to infuse new parts.

DETAILED DESCRIPTION

Develop computational tools to assist in the manufacture, design and certification of new materials and processes. These tools will reduce the time and costs to infuse new materials while also improving reliability. This program is currently focusing on additive manufacturing as this technology has high payoff for NASA and requires computational design tools.

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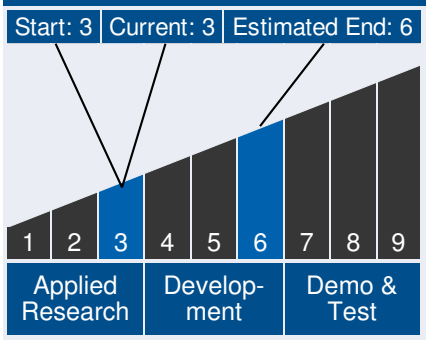
Technology Maturity



Management Team

Program Executive:

- Lanetra Tate

Program Manager:

- Mary Wusk

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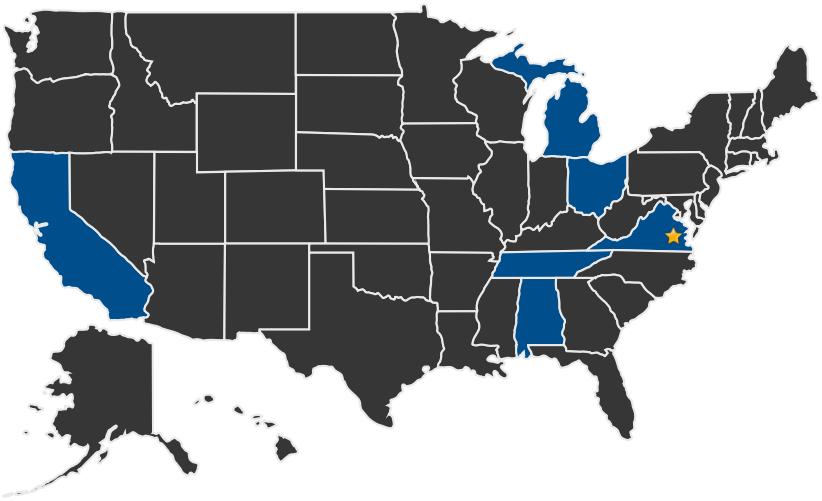
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

- Department of Defense
- Department of Energy
- Lawrence Livermore National Laboratories
- Material Data Management Consortium
- Michigan Technological University
- National Additive Manufacturing Innovation Institute
- NIST
- NSF
- Oak Ridge National Laboratories
- Ohio State University

Management Team *(cont.)*

Project Manager:

- John Vickers

Principal Investigator:

- Lanetra Tate

Technology Areas

Primary Technology Area:
Nanotechnology (TA 10)
- Engineered Materials and Structures (TA 10.1)
  - Lightweight Structures (TA 10.1.1)
    - Nanomaterials Modeling and Simulation (TA 10.1.1.10)
    - Nanomaterials Modeling and Simulation (TA 10.1.1.10)

Secondary Technology Area:
Modeling, Simulation, Information Technology and Processing (TA 11)
- Modeling, Simulation, Information Technology and Processing (TA 11)

Additional Technology Areas:
Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Manufacturing Technologies: Materials Genome Initiative (MGI)

Technology Description

This technology is categorized as a software compiler for engineering, design, modeling, or analysis

Develop integrated computational/experimental/processing methodologies for accerlating discovery and insertion of mateirals to satisfy NASA's unique mission demands

- The challenges:
  1. Validated design tools that incorporate materials properties, processes and design requirements
  2. Materials process control to rapidly mature emerging manufacturing methods to industry ready
- Approach:
  1. Physics-based modeling to guide material design e.g. matrix composition, crosslinking between CNTs, grain size and texture
  2. Multiscale modeling influence of materials design on mechanical properties and durability
  3. Process modeling to determine processing parameters required to produce as-designed material nano-/micro-structures and enable advanced manufacturing methods utilization
  4. Utilize material data management to support robust material design methodology

Capabilities Provided

Affect process development and certification of engine components to be manufactured through Selective Laser Manufacturing (SLM) for use in the Space Launch System (SLS). Computational tools to enable process control with a reduced reliance on trial-and-error approaches will accelerate the development cycle. Simulation of the behavior of components manufactured through the SLM process will be used to inform the certification process to reduce the testing burden and the associated time and cost for future additively manufactured components.

Evaluate optimal material configurations for advanced woven TPS concepts. These concepts are very promising for enabling future missions due to their performance and the highly tailorable material architecture. However, with this tailorability comes a large design space which is impractical to explore through fabrication, as these systems are costly to build and test. Consequently, computationally assisted design is being implemented to assist the design process. Additionally, these design tools will be evaluated for use in predicting the response of these

materials to operational regimes that cannot be examined in the laboratory.

Atomistic simulations will be utilized to design improved interfaces in nanotube reinforced composites to develop these materials for use in ultra-lightweight aerospace structures. The use of computational simulation allows for an efficient means to examine a wide range of chemical formulations.

Potential Applications

Space Launch System (SLS)

Conformal TPS

Nanotechnology