

Nanotechnology (NT): Carbon Nanotube Structural Materials Project

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



ANTICIPATED BENEFITS

To NASA funded missions:

•20% reduction in CFRP panel weight •100% improvement in damage tolerance

To NASA unfunded & planned missions:

Enables significant reductions in launch vehicle mass (up to 30%). Potential application in Composites Exploration Upper Stage Project

To other government agencies:

Department of Defense - lightweighting of vehicles

To the commercial space industry:

Reduction in launch vehicle and satellite mass

To the nation:

Use in transportation vehicles could lead to significant reductions in petroleum consumption and emissions

DETAILED DESCRIPTION

Increase the tensile strength of CNT fibers to produce composites with specific tensile strengths of 2.0 GPa/(g/cc) and demonstrate their impact on the mechanical properties, coefficient of thermal expansion, and damage tolerance of CFRP Approach: Increase tensile strength of commercially available CNT materials via a combination of processing modifications (increased CNT length and improved alignment) and post-processing methods (increase CNT-CNT bond strength) Incorporate into composites and perform coupon level tests to quantify improvements in mechanical properties, damage tolerance and dimensional control Demonstrate benefits and flight readiness by design, fab, ground and flight test of a CNT reinforced COPV Partner with DoD and other agencies under the NNI Sustainable Nanomanufacturing Signature Initiative to

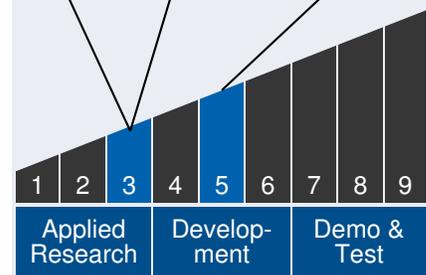


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Technology Maturity

Start: 3 | Current: 3 | Estimated End: 5



Management Team

Program Executive:

- Lanetra Tate

Program Manager:

- Mary Wusk

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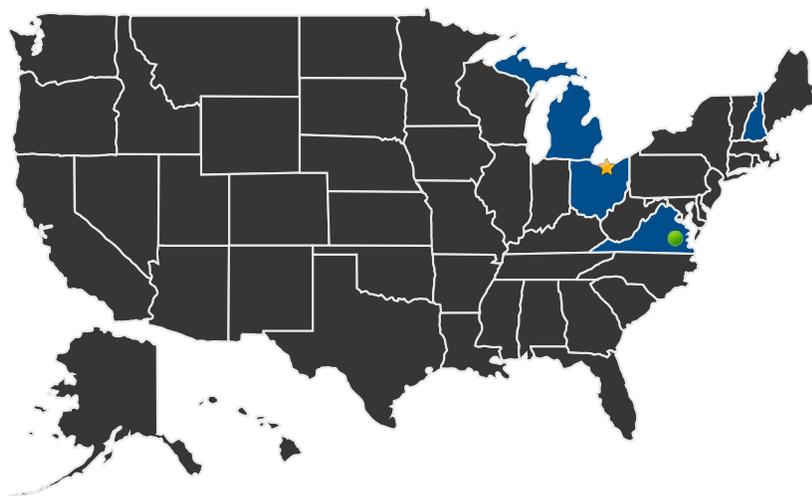
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leverage resources and capabilities Utilize other NASA investments, e.g., Space Technology Research Fellowships, SBIR/STTR to accelerate technology development

U.S. WORK LOCATIONS AND KEY PARTNERS



 U.S. States With Work  **Lead Center:**
Glenn Research Center

 **Supporting Centers:**

- Langley Research Center

Other Organizations Performing Work:

- Kent State University (Kent, OH)
- Michigan Technological University
- Nanocomp Technologies

Contributing Partners:

- Air Force Research Lab/Air Force Office of Scientific Research

Management Team (cont.)

Project Manager:

- Michael Meador

Principal Investigator:

- Peter Lillehei

Co-Investigator:

- Emilie Siochi

Technology Areas

Primary Technology Area:

Nanotechnology (TA 10)

└ Energy Storage, Power Generation, and Power Distribution (TA 10.2)

└ Power Distribution (TA 10.2.3)

└ Carbon Nanotube Based Power and Avionics Cables (TA 10.2.3.1)

Secondary Technology Area:

Nanotechnology (TA 10)

└ Sensors, Electronics, and Devices (TA 10.4)

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Technology Areas (cont.)

Additional Technology Areas:

Nanotechnology (TA 10)

└ Sensors, Electronics, and Devices (TA 10.4)

└ Sensors and Actuators (TA 10.4.1)

└ High Performance Radiation Sensors (TA 10.4.1.2)

└ Gas and Vapor Sensors (TA 10.4.1.4)

└ Nanoelectronics (TA 10.4.2)

└ 1D Nanoelectronics (TA 10.4.2.6)

└ Miniature Instruments and Instrument Components (TA 10.4.3)

└ Portable Integrated Medical Diagnosis Tool for Long-Duration Human Spaceflight (TA 10.4.3.5)

DETAILS FOR TECHNOLOGY 1

Technology Title

Nanotechnology: Carbon Nanotube Structural Materials

Technology Description

This technology is categorized as a material for manned spaceflight

Increase the tensile strength of CNT fibers to 7 to 10 GPa and demonstrate their impact on the mechanical properties, coefficient of thermal expansion, and damage tolerance of CFRP

Approach:

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- Incorporate into composites and perform coupon level tests to quantify improvements in mechanical properties, damage tolerance and dimensional control
- Demonstrate benefits and flight readiness by design, fab, ground and flight test of a CNT reinforced COPV
- Partner with DoD and other agencies under the NNI Sustainable Nanomanufacturing Signature Initiative to leverage resources and capabilities
- Utilize other NASA investments, e.g., Space Technology Research Fellowships, SBIR/STTR to accelerate technology development

Capabilities Provided

Reduced vehicle mass and fuel consumption

Potential Applications

Structural components for launch vehicles, aircraft and spacecraft

Performance Metrics

Metric	Unit	Quantity
Specific tensile strength	GPa/(g/cc)	2.0