

SBIR Topic Number:
AF04-294

SBIR Title:
Temperature Sensitive Paint
for Wind Tunnel Models

Contract Number:
FA9101-05-C-0039

SBIR Company Name:
Space Micro Inc.
San Diego, CA

Technical Project Office:
Arnold Engineering
Development Center
(AEDC), Arnold AFB, TN

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



Left – Temperature sensitive paint (TSP) was tested in the Hot Gas Wind Tunnel at the Marshall Space Flight Center, Redstone Arsenal, Huntsville, Alabama. Right – TSP applied to test bed mounted in wind tunnel.

Improved Temperature Sensitive Paint (TSP) Successfully Used in Wind Tunnel Models

- Current paint alternatives are problematic due to thermal range limitations and the generation of toxic byproducts
- TSP coating demonstrates extreme thermo-mechanical durability, having survived over 60 runs in a high speed wind tunnel at the Marshall Space Flight Center without a removal and rework cycle
- Space Micro's newly-developed TSP process can eliminate low operating temperature limits associated with other paints
- In addition to the use of TSP in high speed wind tunnels, it can benefit other defense agencies, the National Aeronautics and Space Administration, and aerospace companies in the development of high speed aircraft and spacecraft

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Air Force Requirement

The Arnold Engineering Development Center (AEDC) uses high speed wind tunnel research to support the development of advanced aerospace structures that are used in the development of new aerospace weapons systems. Current temperature sensitive paints (TSPs) are problematic due to thermal range limitations and the generation of toxic byproducts. This SBIR project required the development of an enhanced paint to support advanced high speed wind tunnel research and address the shortcomings of existing TSP material systems. The requirements listed below were achieved:

- Thermal operating range of 80 degrees (deg) Fahrenheit (F) to 1200 deg F
- Temperature measurement accuracy of 5 deg F over the entire operating range
- Mechanical stability over multiple high speed runs
- Ease of application and preparation equivalent to current paints
- Uniform coating deposition of nominal +/- 0.001 inch
- A removable product with non-toxic byproducts

SBIR Technology

Space Micro Inc., Advanced Materials Division, developed and delivered an innovative TSP that met the general requirements set forth by the Air Force in this SBIR project. The TSP can eliminate high operating temperature limits associated with current state-of-the-art paints. Further, this work has produced a coating that demonstrates extreme thermo-mechanical durability, having survived over 60 runs in a high speed wind tunnel at the Marshall Space Flight Center without a removal and rework cycle.

The material also demonstrated the ability to operate from near room temperature through 700 deg F during these runs. Application and removal processes have been developed for the new material. A substantial potential savings can be gained through the reduction of removal and reapplication frequency.

Potential Air Force Application

In addition to the use of this paint in high speed wind tunnel work by the Air Force, this material can benefit other agencies, such as the National Aeronautics and Space Administration, the other military services and defense agencies, and aerospace companies (e.g., Boeing) in the development of high speed aircraft and spacecraft.

While there are competitive technologies, it is estimated that thermal sensing within the aerospace and automotive industries could be worth millions of dollars. TSP could find application in

monitoring temperature of critical components, such as engines and nacelles in ground checks. This technology can be further extended into power generation, where the temperature of large turbines could be monitored, providing early warnings of failure.



Paint Deposition Laboratory Process

Aside from providing a technology for high performance TSP, this core technology may well provide a platform for some derivative products that will support Thermal Protection System (TPS) applications, with temperatures in excess of 1300 deg Centigrade (2372 deg F).

Company Impact

This SBIR project provided an opportunity for Space Micro to enhance its expertise in materials R&D processes and expand its potential product lines.

Space Micro is a high technology firm with a special focus on space and military applications. Founded in 2002, Space Micro is a privately held, employee-owned company, with headquarters in San Diego, California. It is a pioneer in providing radiation hardened by design solutions for advanced electronic systems and microelectronics.

Space Micro is completing research in design solutions for single event effects in microelectronics, plus methods for improving single event effects performance of high performance space computers, for several companies and government agencies. Among others, clients include NASA, the Missile Defense Agency, and the Air Force Research Laboratory. Space Micro's emphasis is on advanced materials and coatings, microelectronics, sensors, computers and micro-electromechanical systems.

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