Air Force SBIR/STTR

Innovation

Air Force SBIR/STTR Innovation Story

SBIR Topic Number:
AF04-248

SBIR Title:
Innovative Weight Efficient Combined Structural/ Thermal Protection System (TPS) Concepts

Contract Number:
FA8650-05-C-3558

SBIR Company Name:
FMW Composite Systems, Inc., Bridgeport, WV

Technical Project Office:
AFRL Air Vehicles Directorate, Wright-Patterson AFB, OH

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.

Innovative Weight Efficient Combined Structural/Thermal Protection System (TPS) Concepts

- The Air Force has a requirement for stiff, strong, lightweight, and affordable materials with high temperature capability for use in the next generation of hypersonic cruise and reusable space vehicles
- This technology involves small additions of Boron and Carbon to conventional titanium alloys via a powder metallurgy process to create a new Nano-Phase Titanium class of materials with superior mechanical properties
- Potential Air Force benefits include reducing use of costly insulating tiles and blankets and shrinking structural mass fraction of global range vehicles to permit carriage of more fuel and payload
- Potential additional applications include rocket motor cases on missile programs, hydraulic cylinders made by several actuator manufacturers, and spacecraft heat shields

RBO-09-381

Air Force Requirement

Properties of current structural/thermal protection system (TPS) materials limit the benefit they provide to future Air Force space launch and long-range strike capabilities. Stiff, strong, lightweight, affordable materials with elevated temperature applicability are required to develop the next generation of space vehicles that will provide reusable access to low Earth orbit (LEO) and hypersonic cruise vehicles that will operate in the range of Mach 6 to 8.

SBIR Technology

Conventional titanium alloys, enhanced with minor additions of Boron and Carbon via a powder metallurgy process, were developed to create a new material class called Nano-Phase Titanium. Strength and stiffness increases of more than 25 percent have been realized, while maintaining ductility and workability of the alloy. Rolling, forging, and extruding this material forms products that can be used for primary airframe structural applications in hot environments; temperatures between 300ºF and 1,100ºF were demonstrated. We have worked under a teaming arrangement with Crucible Research to expand the understanding and potential uses of this exciting new alloy class.

Potential Air Force Application

The benefit to the Air Force of this new structural application is in reducing or eliminating the use of insulating tiles and blankets which are extremely costly to maintain and have limited functionality in adverse weather. The strength and weight advantage of Nano-Phase Titanium over current, heavier metals will shrink the structural mass fraction of global range vehicles to enable more fuel and payload to be carried. It is also being evaluated for motor cases in missile programs such as Tomahawk and Advanced Medium-Range Air-to-Air Missile (AMRAAM).

Company Impact

This Phase II SBIR program has already has had a significant impact on FMW Composite Systems' sales and products. The demonstration of near isotropic properties in the rolling trials (see Figure 1) conducted under this SBIR has opened up several new product areas for FMW Composite Systems. The demonstration of hot-worked, nano-enhanced titanium to provide the ability to handle complex load fields has led to other applications including rocket motor cases and hydraulic cylinders. Several actuator manufacturers are considering using this technology in Product Improvement Programs

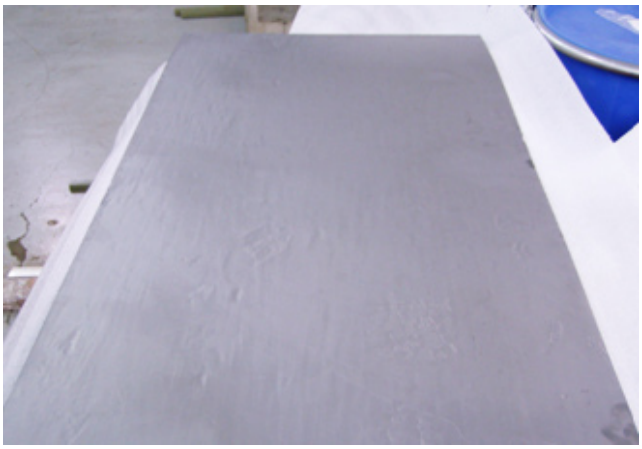

Figure 1: Rolling Trial Plate

to military and commercial actuators. Our demonstrated nano-enhanced titanium processing success has also resulted in a contract to evaluate this material for spacecraft heat shield applications.

The conceptual use of nano-enhanced titanium has drawn Department of Defense user interest from the Space Operations Vehicle (SOV) and Defense Advanced Research Projects Agency (DARPA)/Air Force FALCON (Force Application and Launch from CONUS) communities. Upon completion of this Phase II SBIR, we expect to receive several component development programs from the Air Force, DARPA and as many as three prime aerospace contractors.

In summary, the success of FMW Composite Systems under this SBIR program has led to the receipt of new contracts exceeding $800K and has opened up several promising new product areas for our company.

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Air Force SBIR Program
AFRL/XP
1864 4th Street
Wright-Patterson AFB OH 45433

AF SBIR/STTR Program Manager: Augustine Vu
Website: www.sbirsttrmall.com
Comm: (800) 222-0336
Fax: (937) 255-2219
e-mail: afrl.xppn.dl.sbir.hq@wpafb.af.mil

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