

SBIR Topic Number:
AF04-199

SBIR Title:
Advanced Rocket
Propulsion Technologies

Contract Number:
FA9300-05-C-0019

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

Technical Project Office:
AFRL Propulsion
Directorate, Edwards
AFB, CA

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.



Nano-enhanced titanium alloy tactical rocket motor cases

Advanced High Mass Fraction Tactical Rocket Motor Case

- The Air Force has a requirement to reduce the inert weight of missile systems in order to raise the mass fraction for propulsion and, in-turn, increase both missile range and payloads.
- The specific bearing strength of the new nano-enhanced Ti-6Al-4V alloy was shown to be 90% greater than the baseline aluminum alloy and 40% greater than the baseline titanium alloy.
- FMW Composite Systems has developed a new class of nano-enhanced titanium alloys, via an innovative powder metallurgy process, that has much improved mechanical properties.
- Potential Air Force applications for this technology include Advanced Medium-Range Air-to-Air Missile (AMRAAM), Global Strike, Tomahawk, and Joint Dual Role Air Dominance Missile (JDRADM).

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Air Force Requirement

The Air Force has a requirement to advance rocket propulsion technologies during the next decade. As a prime example, a reduction in the inert weight of missile systems would enable a greater mass fraction for propulsion, which in-turn enhances missile range and allows increased payloads. Achieving a higher mass fraction using available light-weight materials is challenging due to volume constraints imposed in current systems such as the Advanced Medium-Range Air-to-Air Missile (AMRAAM). Higher performance requirements for future high-mach-number vehicles would require advances in material technologies to provide superior weight-specific as well as volume-specific properties.

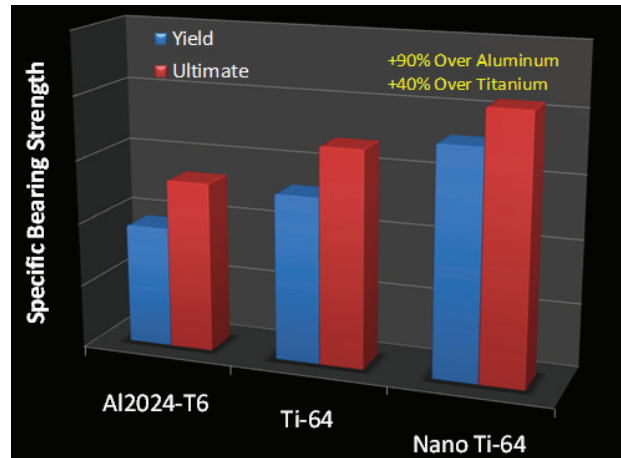
SBIR Technology

FMW Composite Systems, Inc. has developed a new class of nano-enhanced titanium alloys via an innovative powder metallurgy process. During this SBIR program, they demonstrated the successful scale-up of nano-enhanced titanium alloy motor case technology, and its potential for weight savings, by applying this technology to the Minuteman III Stage I-II interstage. As shown on the previous page, several AMRAAM sized cases were successfully fabricated based on flowforming technology. Process parameters were optimized and the ability to affordably flowform this material was demonstrated. It was also determined that this material could be electron beam (EB) welded similar to the baseline titanium alloy with both acceptable weld quality and tensile properties.

In collaboration with ATK, the Minuteman III Stage I-II interstage of Global Strike was evaluated to determine the potential benefits, from an overall system perspective, of replacing the current aluminum structure with nano-enhanced titanium structure. Preliminary design trade studies were performed supported by component-specific test data. Preliminary design analysis performed at ATK using estimated design allowables on nano-enhanced titanium alloy revealed the potential for a 90 lb weight reduction for the insulated structure. This represents a significant performance improvement over the current baseline aluminum alloy. Thus, the manufacturability and potential weight reduction offered by nano-enhanced titanium has been demonstrated.

Potential Air Force Application

The breakthrough potential of nano-enhanced titanium alloys has broad implications for families of future Air Force weapon



Increased strength of nano-enhanced titanium alloy compared to baseline aluminum and titanium alloys

systems such as Global Strike, on which the Minuteman III Stage I-II interstage was identified as a potential weight reduction/performance improvement opportunity. Preliminary design analysis performed at ATK, using estimated design allowables on nano-enhanced Ti-6Al-4V alloy, revealed significant performance improvements over current baseline aluminum alloy. Pin bearing strength data on the optimized enhanced titanium alloy in the desired product form was generated. As shown in the above figure, the specific bearing strength of nano-enhanced titanium alloy is 90% greater than the baseline aluminum alloy. This combination of weight reduction and performance improvements would lead to increases in both range and payload. Other potential Air Force applications of this technology include Tomahawk and the Joint Dual Role Air Dominance Missile (JDRADM).

Company Impact

The successful demonstration of flowformability of nano-enhanced titanium alloys has opened up several promising new product areas, such as warheads, links, struts, shafts, pistons, and housings, for FMW Composite Systems. Technology maturation and system level demonstrations are currently being pursued under a Phase III program. Upon completion of this SBIR development effort, FMW Composite Systems expects to receive several component orders from various DoD prime contractors.



SBIR/STTR

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