

SBIR Topic Number:
AF05-170

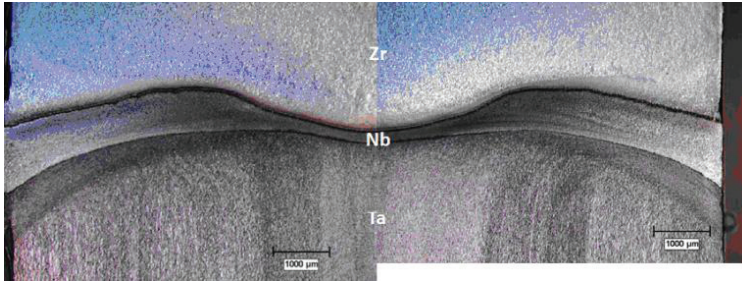
SBIR Title:
Material Bonding
for Lethal Air-to-Air
Warheads

Contract Number:
FA8651-06-C-0129

SBIR Company Name:
HYTEC, Inc.,
Los Alamos, NM

Technical Project Office:
AFRL Munitions
Directorate,
Eglin AFB, FL

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: Ta/Zr welded specimen with Nb interlayer. Right: Recovered bonded fragments that have been explosively launched demonstrating robust survivability.

Material Bonding of Tantalum and Zirconium for Advanced Warhead Lethality

- The Air Force has a requirement for a bonded warhead fragment concept that has desired penetration and other weapons effects, such as high energy release and pyrophoricity
- HYTEC selected Tantalum (Ta) for high density and penetration ability, Zirconium (Zr) for pyrophoricity/ weapons effects, and Niobium (Nb) to bridge between the Ta and Zr – an “interlayer”
- The ability to routinely produce, at low cost and in high volume, weapon subsystems which have high penetrability and high energy release could readily complement new weapon designs
- The development of a quality-assured inertia friction welding process for multi-material parts has commercial aerospace applications (such as drum rotors and shafts for engines, and structural components in airframes such as aluminum to titanium welded joints)

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Air Force Requirement

The goal of this SBIR project was to design, fabricate, and demonstrate a bonded warhead fragment concept that has desired penetration and other weapons effects, such as high energy release and pyrophoricity. This warhead design component could complement existing warhead designs used in air-to-air warfare.

HYTEC's proposed method of fabrication was an innovative welding technique, supported by an advanced in-process welding quality assurance method which together would demonstrate a proof of manufacturability.

SBIR Technology

The materials selected were Tantalum (Ta) for high density and penetration ability, Zirconium (Zr) for pyrophoricity/ weapons effects, and Niobium (Nb) to bridge between the Ta and Zr – an "interlayer." The welding method was Inertial Friction Welding (IFRW), a well-known welding method in aerospace and automotive manufacturing.

The innovative on-machine, real-time process monitoring and quality assurance method and tool were tested and proven. The resulting munition fragments passed ballistic testing and initial explosive launch testing.

Potential Air Force Application

New weapon concepts are under study at U.S. Air Force and other Department of Defense laboratories. The ability to routinely produce, at low cost and in high volume, weapon subsystems which, within existing weight/form/balance parameters, have high penetrability and high energy release could complement new weapon designs.

Commercial applications of this work are numerous. First, the development of a quality-assured inertia friction welding process for multi-material parts has aerospace applications such as drum rotors and shafts for engines, and structural components in airframes such as aluminum to titanium welded joints. Second, there are potential applications in the automotive sector, where the technology could provide an attractive way to reliably join aluminum to steel for advanced lightweight automobile bodies and other vehicular concepts.

Company Impact

"What our team was able to accomplish in this program advanced our understanding of the strength of this compound welding technique and as well it demonstrated our partner Beyond 6 Sigma's In Process Quality Assurance (IPQA) system in yet another welding application. These developments add credibility to our approach and should lead to increased sales and licensing opportunities in the near future," according to Dr. C. Robert Kline, the program manager at HYTEC.

HYTEC is a leader in the development and marketing of cutting-edge dental products and highly sophisticated engineering technology. The company has developed scanning systems that drive the Invisalign® technology for orthodontists and has also developed state-of-the-art devices for pre and post-flight scanning of NASA's space shuttle tiles.



SBIR/STTR

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