Enabling Hybridized Manufacturing Processes for Lightweight Body Armor

Provides the development, integration, and deployment of new, scalable manufacturing technologies to enable lighter body armor by exploiting advances in both multi-scale material and process technologies.

OBJECTIVE / SOLUTION

The U.S. Army, and indeed the DoD-wide small arms body armor user community, has requested that lighter versions of their highly successful ceramic-based armor be developed and fielded as soon as possible. The objective of this ManTech effort is to develop an integrated suite of manufacturing technologies based on recent material and process advances which can cumulatively deliver the same level of protection with at least a 10% reduction in total system weight.

ACHIEVEMENTS

• Designed, built, and deployed first generation Backing Assembly Machine (BAM) for the semi-automated, precisely controlled buildup of multioriented fiber architectures and functionally graded resin treated fabrics
• Incremental Pressure Application System (IPAS) brought on line and in the preliminary “shake down” phase for the fabrication of locally consolidated thermoplastic backing materials (including ultra high molecular weight polyethylene materials)
• Successfully demonstrated initial process for fabrication of highly conformal, fully dense B₄C at full thickness

BENEFITS

• 20-30% touch labor reduction by the development and implementation automated and semi-automated material handling and stacking technologies
• Cumulative 10% weight reduction in ceramic/composite body armor systems
• Ability to co-process ceramic and polymer composite hydrostatically at pressures in excess of 5000 psi
• Semi-automation and integrated batch operations allow for 15-30% reduction in assembly cycle time

STATUS

• Exercising Backing Assembly Machine in the cycle-efficient assembly of uni-directional (including cross plied) materials
• Fabricated array of partially consolidated thermoplastic backing material under locally controlled heat, pressure, and cool down phases
• Fabricated ceramic plates using novel ceramic composition and modified extrusion process

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WEAPON SYSTEMS / SECONDARY ITEMS IMPACTED

• Small Arms Protective Inserts (SAPI)
• Enhanced Small Arms Protective Inserts (ESAPI)
• X-Threat Small Arms Protective Inserts (XSAPI)
• Deltoid Auxiliary Protection System (DAPS)
• Side Plate Protection Systems
• Potentially commercial applications include law enforcement and private protection personnel armor systems

POTENTIAL COST AVOIDANCE

• Return on Investment of 12.0 to 1 with a cost benefit of $96M