U.S. Army Research Laboratory

Protecting America's Soldiers Against Weapon Threats

U.S. Army Soldier and Biological/Chemical Command

LIGHTWEIGHT PERSONNEL PROTECTION

The U.S. Army Research Laboratory (ARL) and the U.S. Army Soldier and Biological/Chemical Command (SBCCOM) are working together to develop and apply advanced technologies for individual protection systems that can defeat or neutralize anti-personnel weapon threats at significantly reduced weights.

Basic Research

- Characterization of Dynamic Properties of Materials
- Material Dynamics Modeling and Simulation
- Synthesis and Characterization of Nanomaterials
- Formulation and Characterization of Polymeric Barrier Materials

Applied Research

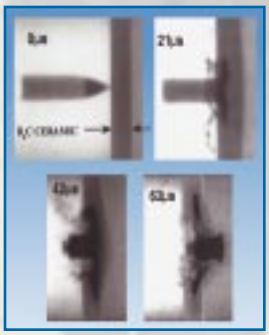
- Experimental Determination of Ballistic Performance of Candidate Materials
- Design Guidelines and Candidate Selection Criteria Development
- Processing and Fabrication of Candidate Armor Systems
- Characterization of Effectiveness of Nanomaterial Coatings against Chemical and Biological Threats
- Processing and Characterization of Advanced Respirator Components and Protective Clothing Systems

Goals

- Higher Mass Efficiency (improved protection, lighter weight)
- Expanded Applications
- Enhanced Area of Coverage
- Enhanced Mobility
- Reduced Cost (maturation of notional technologies)

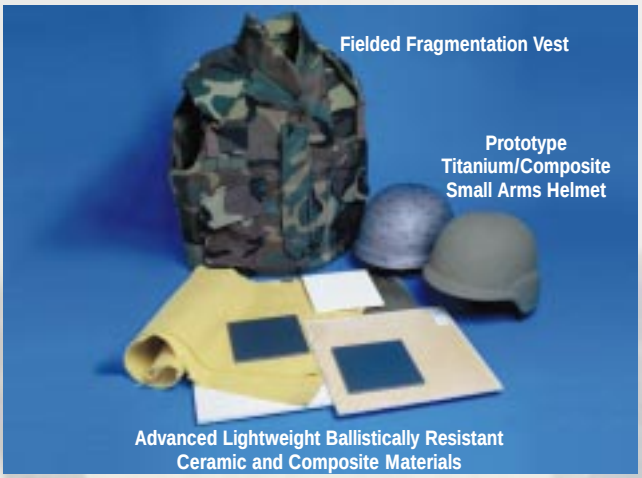
Fielded Ballistically Resistant Vest and Kevlar Helmet

Concealable Ceramic Armor for Small Arms Protection



Ballistic Testing (Dynamic X-Ray of 7.62-mm Projectile into Ceramic Composite)

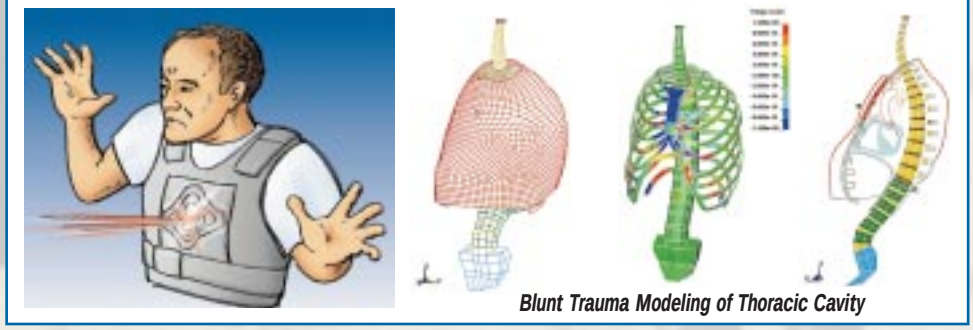
Conceptual Illustration of Future Soldiers with Multifunctional Battle Dress Uniforms in Chemical/Biological Warfare Environment



Advanced Lightweight Ballistically Resistant
Ceramic and Composite Materials

ARL and SBCCOM are working together to develop and apply advanced technologies for individual protection systems that can defeat or neutralize anti-personnel threats at significantly reduced weights. Advanced materials, such as ceramics, fibers, and polymer-matrix composites, are being coupled with new processing technologies and armor designs for application in new, concealable personnel protection systems. A particular concern is the need to develop armor designs capable of defeating armor-piercing small-arms threats at reduced aerial weight densities, with multihit capability, and without imposing limitations on the soldier's mobility.

The focus for the personnel armor system has been on developing an armor design consisting of ceramic tile backed with a fiber-reinforced polymeric composite laminate. Candidate materials for the ceramic tile include aluminum nitrate, aluminum oxide, boron carbide, and silicon carbide. Candidate materials for the composite laminates include glass/polyester, aramid/phenolic, and spectra/polyurethane. Apromising new research effort is nanoparticulates, where ceramic materials with optimized microstructures are processed into inorganic ballistically resistant components at very high mass efficiencies. These materials are being characterized through numerical simulation and high-fidelity experimentation to evaluate the effects of thickness, weight, and mechanical properties of the material components on the ballistic performance of the system. Blunt trauma modeling is providing even further insight into the effects of non-penetrating bullet and fragment impact on the soldier's torso and other anatomical components. ARL researchers are collaborating with scientists from the Armed Forces Institute of Pathology, the Medical Research and Development Command, and other agencies to develop a reliable blunt trauma modeling and experimentation program capable of providing an accurate predictive response tool for supporting new personnel armor designs.



Blunt Trauma Modeling of Thoracic Cavity

An example of successful transition of technology from the laboratory to the field is in the development of transparent armor designs to improved face shields. ARL teamed with the Aberdeen Test Center and Paulson Manufacturing Corporationto develop an improved face shield using a high impact grade polycarbonate resin, novel coating technology, and processing modifications to reduce residual stress in the visor. The new visors, deployed to troops in Kosovo, withstood repeated impacts from rocks and tree limbs without cracking or shattering.

FOR FURTHER INFORMATION

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