Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army											Date: March 2014	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602105A *I MATERIALS TECHNOLOGY*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	54.578	55.569	28.006	-	28.006	28.481	30.448	30.844	31.567	-	-
H7B: *Advanced Materials Initiatives (CA)*	-	26.724	28.998	-	-	-	-	-	-	-	-	-
H7G: *Nanomaterials Applied Research*	-	4.378	3.987	3.325	-	3.325	3.700	5.490	5.393	5.885	-	-
H84: *Materials*	-	23.476	22.584	24.681	-	24.681	24.781	24.958	25.451	25.682	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

FY 13Adjustments attributed to Congressional Add funding (32.000 million); Congressional General Reductions (-107 thousand); SBIR/STTR transfers (-376 thousand); and Sequestration reductions (-5.980 million)
FY 14 Adjustments attributed to Congressional Add funding (29.000 million) and FFRDC reduction (-16 thousand)

A. Mission Description and Budget Item Justification

This program element (PE) evaluates materials for lighter weight and more survivable armor and for more lethal armaments. Project H7G researches and explores nanostructure materials properties and exploits the strength and durability of these materials to enable lighter weight, increased performance in Soldier weapons and protection applications. Project H84, researches a variety of materials and designs, fabricates and evaluates performance of components for lighter weight Soldier and vehicle armors, armaments, and electronics.

Work in this PE builds on the materials research transitioned from PE 0601102A (Defense Research Sciences), project H42 (Materials and Mechanics) and PE 0601104A (University and Industry Research Centers), project J12 (Institute for Soldier Nanotechnologies). This work complements and is fully coordinated with PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602618A (Ballistics Technology), PE 0602786A (Warfighter Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle Advanced Technology), and PE 0708045A (Manufacturing Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work is performed by the U.S. Army Research Laboratory (ARL), Adelphi, MD and Aberdeen Proving Ground, MD, and the Massachusetts Institute of Technology.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army					Date: March 2014
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602105A / *MATERIALS TECHNOLOGY*			
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	29.041	26.585	29.955	-	29.955
Current President's Budget	54.578	55.569	28.006	-	28.006
Total Adjustments	25.537	28.984	-1.949	-	-1.949
• Congressional General Reductions	-0.107	-0.016			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	32.000	29.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.376	-			
• Adjustments to Budget Years	-	-	-1.949	-	-1.949
• Other Adjustments 1	-5.980	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army												Date: March 2014
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602105A / *MATERIALS TECHNOLOGY*				Project (Number/Name) H7B / *Advanced Materials Initiatives (CA)*			
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
H7B: *Advanced Materials Initiatives (CA)*	-	26.724	28.998	-	-	-	-	-	-	-	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Advanced Materials Initiatives.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Nanotechnology Research ***Description:*** This is a Congressional Interest Item. ***FY 2013 Accomplishments:*** Developed tools and methodologies to create and retain unique nano-derived properties from nano-synthesis through component processing. ***FY 2014 Plans:*** This is a Congressional Interest Item.	7.516	4.000	-
Title: Materials Research ***Description:*** This is a Congressional Interest Item ***FY 2013 Accomplishments:*** Researched non-flammable high voltage battery electrolytes for safe high energy density lithium ion power sources; researched rechargeable high energy density proton conducting power sources; researched domestic sources and recovery processes for rare earth metals. ***FY 2014 Plans:*** This is a Congressional Interest Item	10.857	14.999	-
Title: Advanced Coating Technologies for Corrosion Mitigation ***Description:*** This is a Congressional Interest Item	8.351	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *MATERIALS TECHNOLOGY*	**Project (Number/Name)** H7B / *Advanced Materials Initiatives (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Researched corrosion mitigation mechanisms and failures of Army substrates and coatings; develop and characterize advanced coatings that use no chemicals that pose significant hazards to human health or the environment and/or are derived from renewable resources.			
Title: Silicon Carbide Research ***Description:*** This is a Congressional Interest Item ***FY 2014 Plans:*** This is a Congressional Interest Item	-	9.999	-
Accomplishments/Planned Programs Subtotals	26.724	28.998	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602105A / *MATERIALS TECHNOLOGY*	Project (Number/Name) H7G / *Nanomaterials Applied Research*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H7G: *Nanomaterials Applied Research*	-	4.378	3.987	3.325	-	3.325	3.700	5.490	5.393	5.885	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This effort conducts nanoscience research relevant to the Soldier focused on new materials, properties and phenomena in five research areas: (1) lightweight, multifunctional nanostructured materials and hybrid assemblies, (2) soldier medicine, (3) multiple blast and ballistic threats, (4) hazardous substances sensing, recognition, and protection, and (5) nanosystem integration for protected communications, diagnostic sensing, and operational flexibility in complex environments. This project funds collaborative applied research and integration of government, academic, and industry scientific research on nanomaterials derived from PE 0601104A/ project J12 (Institute for Soldier Nanotechnologies (ISN)) to advance innovative capabilities.

This project sustains Army science and technology efforts supporting the Soldier portfolio.

Work in this project builds on the materials research transitioned from PE 0601104A. This work complements and is fully coordinated with PE 0602618A (Ballistics Technology), PE 0602786A (Warfighter Technology), and PE 0603001A (Warfighter Advanced Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the U.S. Army Research Laboratory (ARL), Adelphi, MD and Aberdeen Proving Ground, MD, the Massachusetts Institute of Technology, and the ISN industrial partners.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Nanomaterials Applied Research	4.378	3.987	3.325
Description: Devise and validate improved physics-based, materials property models and concepts for multifunctional, lightweight, and responsive materials. Exploit breakthroughs in nanomaterials and multifunctional fiber processing technologies, such as scale-up of processes and fabrication into woven materials,) to enable revolutionary future Soldier capabilities.			
FY 2013 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *MATERIALS TECHNOLOGY*	**Project (Number/Name)** H7G / *Nanomaterials Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continued to design novel sensor and imaging devices based on carbon nanotube, quantum dot, and photonic crystal technologies; and scaled-up nanometallic aluminum alloy processing to characterize performance for potential ballistic protective materials. ***FY 2014 Plans:*** Develop quantum dot-based optical taggant system that will enable daylight visible tag, track, and locate (TTL) and combat identification capabilities; validate hydrophobic and antimicrobial coating technology on fabrics; and validate high rate response of nanometallic aluminum alloys for use in lightweight protection systems. ***FY 2015 Plans:*** Will develop new materials capable of selective energy absorption based on novel coating technologies using nano- and microparticle; synthesize unique molecules for use as additives in transparent eye protection materials that simultaneously solve processing issues and enhance material performance; and demonstrate stability and performance of a daylight visible taggant system based on a quantum dot-enabled paint for covert tracking and combat identification applications.			
Accomplishments/Planned Programs Subtotals	4.378	3.987	3.325

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602105A / *MATERIALS TECHNOLOGY*	Project (Number/Name) H84 / *Materials*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H84: *Materials*	-	23.476	22.584	24.681	-	24.681	24.781	24.958	25.451	25.682	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project designs, fabricates, and evaluates a variety of materials (including metals, ceramics, polymers, and composites) that have potential to enable more survivable, lighter weight Soldier and vehicle armor, chemical and biological protection, armaments, and electronics. Research conducted focuses on unique and/or novel material properties, developing physics-based models, materials characterization techniques, non-destructive testing methods and advanced fabrication/processing methodologies.

This project sustains Army science and technology efforts supporting the Ground and Soldier portfolio.

Work in this project makes extensive use of high performance computing and experimental validation and builds on research transitioned from PE 0601102A (Defense Research Sciences), project H42 (Materials and Mechanics) and project H43 (Ballistics). The work complements and is fully coordinated with efforts in PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602618A (Survivability and Lethality Technologies), PE 0602786A (Warfighter Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle Advanced Technology), and PE 0708045A (Manufacturing Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

The work is conducted by the U.S. Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Structural Armor	3.261	2.521	5.417
Description: Conduct applied research to design and evaluate lightweight armor materials and structures, investigate novel processing methodologies for cost effective manufacturing, and utilize existing and emerging modeling and simulation tools to enable formulation of lightweight, frontal, and structural armor materials for current and future platform applications.			
FY 2013 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *MATERIALS TECHNOLOGY*	**Project (Number/Name)** H84 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Investigated novel mechanical deformation processing of magnesium alloy plates that potentially provide very lightweight metal structural materials; provided corrosion mapping for promising aluminum and magnesium alloys and investigated corrosion inhibitors to enable the alloys use for future applications; documented materials properties information (such as adhesive strength) for an adhesive database to be used in close collaboration with manufacturers and research universities; fabricated novel boron sub-oxide ceramic materials for use in protection applications; and validated progressive failure analysis methods and progressive fatigue damage model of composites under various loadings and composite configurations to improve long term reliability of composite materials. ***FY 2014 Plans:*** In ceramic armor materials, determine relationships between electronic signals from non-destructive characterization tools and microscopically observed structural details and develop analysis algorithms used for modeling, process feedback and ballistic characteristics; develop aluminum alloys for blast and penetration resistance, emphasizing full scale fabrication for alloy chemistries optimized for the most beneficial metallurgical, mechanical and formability characteristics; and develop novel processing strategies for polymer compositions to enable tunable mechanical response; and apply processing science, and modeling and simulation to validate processing technology for the metallic encapsulation of ceramic armor tiles. ***FY 2015 Plans:*** Will develop improved delamination resistance and damage tolerance of thick composites using innovative, cost-effective manufacturing concepts; demonstrate ballistic performance of monolithic baseline magnesium (Mg) alloy and layered ceramic/Mg alloy/ultra-high-molecular-weight polyethylene (UHMWPE) sandwich structure variants with weight reduction goal of 5-12% over current designs; develop validated physics-based models for fatigue of Mg alloy structures for lightweight vehicles that eliminate traditional empirical modeling approaches; and validate novel algorithms to identify links between the microstructure of armor ceramics and ballistic performance, enabling both screening of as-processed tiles as well as development of next generation armor ceramics.			
Title: Soldier-Borne Armor Materials	4.162	5.398	5.402
Description: Utilizing understanding of defeat mechanisms from PE62618/project H80, conduct applied research of emerging lightweight armor materials and structures to enable affordable design of multifunctional ballistic protective systems for the future Soldier. Provide quantitative scientific basis for modeling and simulation that result in materials that utilize new lethal mechanisms/protection schemes for the individual Warfighter. ***FY 2013 Accomplishments:*** Investigated novel materials such as three-dimensional (3D) ceramics and fabrics to provide breakthrough technologies for protecting the dismounted soldier under ballistic and blast conditions based on human tissue response data; designed novel hybrid material systems with associated processing science to provide lighter, more flexible, more durable and affordable			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *MATERIALS TECHNOLOGY*	**Project (Number/Name)** H84 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
protection to Soldiers and vehicles; and transitioned fabric ballistic modeling tools to armor designers at the U.S. Army Natick Soldier Research, Development, and Engineering Center (NSRDEC) and the U.S. Army Tank and Automotive Research, Development, and Engineering Center (TARDEC). ***FY 2014 Plans:*** Develop synthesis and processing routes for low density boron-based ceramic compositions, provide model validation using high resolution electron microscopy; develop soft polymers through computational methods and experimental validation to match the rate dependent response of relevant human tissues; develop a robust fiber ballistic modeling tool to investigate penetration resistance of up to 10 layers of 2D fabric with multiple fiber or material architectures and validate with ballistic testing; and develop a refined process model to describe the deformation characteristics and fiber-matrix adhesion, provide experimental validation. ***FY 2015 Plans:*** Will develop a filament-level 3D textile model for use in the development of soft body armor; develop and characterize new materials for extremity armor; and develop validated numerical modeling capability to analyze new materials for the range of personnel protection options that utilize the inherent multifunctional nature of composite materials to enhance survivability.			
Title: Composites ***Description:*** This effort designs, models, validates, and optimizes advanced materials (such as ceramic, composite, polymers, lightweight and high-strength metals) including processing techniques for protection against smaller but more lethal penetrators/ warheads using affordable, lightweight, high performance armaments for revolutionary weapons effectiveness in urban and irregular operations. ***FY 2013 Accomplishments:*** Evaluated composite cladding for reduced gun barrel erosion and transitioned to the U.S. Army Armaments Research, Development, and Engineering Center (ARDEC); and demonstrated structures in various media for active and passive wave mitigation and pulsation management for blast applications and acoustic damping. ***FY 2014 Plans:*** Validate improved multi-hit ballistic capability of three-dimensional, through-thickness reinforced (3D-TTR) hybridized composite test coupons; through the use of computational and experimental methods, design and prepare polymer resins derived from renewable sources that provide properties at least equivalent to conventionally prepared polyether ether ketone (PEEK); and develop materials models and experimental techniques to validate >50% improvement in the adhesion of dissimilar materials used in vehicle protection platforms. ***FY 2015 Plans:***	2.923	2.932	4.494

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *MATERIALS TECHNOLOGY*	**Project (Number/Name)** H84 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Will develop metal matrix composites to meet thermal requirements of gun barrels at reduced weight; utilize combination of consolidation and diffusion processes to create nanostructured copper materials for coatings/liners that enable reduction in shape charge jet size while maintaining jet effect; and explore interfacial/bonding effects on the coupled and high loading rate failure modes in thermoplastic composites.			
Title: Multifunctional Armor Materials ***Description:*** This effort researches novel multifunctional armor materials for Army applications such as structural energy storage, armor embedded command, control and communications (C3) antennas, and self healing materials. Soldier personnel protection materials transition to PE 0602786A/project H98. Reactive armor and electromagnetic armor materials transition to PE 0602618A/ project H80 and PE 0602601A/project C05. ***FY 2013 Accomplishments:*** Designed, synthesized, and characterized fiber materials based on biological material mechanics; transitioned new self-healing technologies to composite fabricators to enhance materials durability; created analytical models to design battery storage composites that can be used in future multifunctional structural composite materials that provide structure and energy storage; and investigated improvements in resins, reinforcements, electrodes, and processing techniques to fabricate relevant-size structural capacitors for future multifunctional structural composite materials. ***FY 2014 Plans:*** Research comprehensive armor materials technologies which include multifunctional batteries and/or capacitors (combined structural armor/power storage materials) with minimum of 1 Wh/kg (energy density), 100 mW/Kg (power density), 20 GPa strength (fiber direction); support total armor materials development via formulation of chemical agent resistive coatings (CARC) to reduce corrosion, improve decontamination and lessen solar loading; assess non-local theory and numerical methods for the failure of complex materials subjected to strong electromagnetic fields, validate with experiments; and determine synthetic viability of novel third generation chromophores for use in thick polymer laser protective materials. ***FY 2015 Plans:*** Will validate new embedded power and enhanced survivability capabilities in multifunctional composite materials using enhanced modeling and processing techniques ; develop new additive manufacturing capabilities using three dimenstional (3-D) printing, cold spray, and/or related techniques to explore methods for low-volume production as well as expanding design space (e.g., bio-inspired protection concepts); establish electric field effects on select ceramics and metals to enable Electric Field Assisted Sintering (EFAS) of new multifunctional materials; and identify inelastic deformation mechanisms as a function of strain rate in silicon carbide armor ceramics through development of novel experimental techniques.	11.553	9.929	7.362
Title: Nanomaterials	1.577	1.804	2.006

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *MATERIALS TECHNOLOGY*	**Project (Number/Name)** H84 / *Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Mature and scale-up nanomaterials processes, fabrication, characterization and performance measures to enable revolutionary concepts for future force lethality and survivability beyond those addressed for individual Soldier protection in PE 062105/project H7G. ***FY 2013 Accomplishments:*** Designed synthetic, strain rate dependent polymers to mimic human body tissue; designed and evaluated blast resistant cellular topologies using bio-inspired computational algorithms; demonstrated transparent, nano-architectured cellulose based composite materials; and investigated nano-tungsten materials to evaluate engineering properties for ballistic launch survivability. ***FY 2014 Plans:*** Develop thermally stable, dispersible nanocrystalline cellulose for use in transparent materials to improve the stiffness by 25% without optical penalty; develop powder production technology for reliable, cost effective production of domestic nanocrystalline tungsten; and identify tungsten carbide microstructures and properties for rigid body penetration of armor; and develop environmentally friendly binder materials for tungsten carbide. ***FY 2015 Plans:*** Will develop thermally stable nanocrystalline cellulous particles and networks for incorporation into impact resistant transparent polymers used for personnel protection; establish bulk mechanical properties of thermally stabilized nanocrystalline alloys to expand design space for structural and armor applications; and synthesize novel third generation chromophores and incorporate into thick polymer laser protective materials used in anti-laser sensor devices.			
Accomplishments/Planned Programs Subtotals	23.476	22.584	24.681

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A