Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army										DATE: February 2012	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*							
COST ($ in Millions)	**FY 2011**	**FY 2012**	**FY 2013 Base**	**FY 2013 OCO**	**FY 2013 Total**	**FY 2014**	**FY 2015**	**FY 2016**	**FY 2017**	**Cost To Complete**	**Total Cost**
Total Program Element	28.730	50.679	29.041	-	29.041	26.592	28.890	29.009	29.237	Continuing	Continuing
H7B: *Advanced Materials Initiatives (CA)*	-	20.468	-	-	-	-	-	-	-	Continuing	Continuing
H7G: *NANOMATERIALS APPLIED RESEARCH*	4.714	5.291	4.912	-	4.912	4.989	5.622	5.696	5.789	Continuing	Continuing
H84: *MATERIALS*	24.016	24.920	24.129	-	24.129	21.603	23.268	23.313	23.448	Continuing	Continuing

Note

FY12 funding increase for congressional add.

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 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 2013 Army					DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*		R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*			
B. Program Change Summary ($ in Millions)	**FY 2011**	**FY 2012**	**FY 2013 Base**	**FY 2013 OCO**	**FY 2013 Total**
Previous President's Budget	29.882	30.258	27.999	-	27.999
Current President's Budget	28.730	50.679	29.041	-	29.041
Total Adjustments	-1.152	20.421	1.042	-	1.042
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	20.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.400	-			
• Adjustments to Budget Years	-	-	1.042	-	1.042
• Other Adjustments 1	-0.752	-0.079	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H7B: *Advanced Materials Initiatives (CA)*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H7B: *Advanced Materials Initiatives (CA)*	-	20.468	-	-	-	-	-	-	-	Continuing	Continuing

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 2011	FY 2012	FY 2013
Title: Nanotechnology Research ***Description:*** This is a Congressional Interest Item. ***FY 2012 Plans:*** Congressional add funding for Nanotechnology Research	-	7.998	-
Title: Silicon Carbide Research ***Description:*** This is a Congressional Interest Item. ***FY 2012 Plans:*** Congressional add funding for Silicon Carbide Research.	-	12.470	-
Accomplishments/Planned Programs Subtotals	-	20.468	-

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H7G: *NANOMATERIALS APPLIED RESEARCH*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H7G: *NANOMATERIALS APPLIED RESEARCH*	4.714	5.291	4.912	-	4.912	4.989	5.622	5.696	5.789	Continuing	Continuing

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 fibers and materials, (2) battle suit medicine, (3) blast and ballistic protection, (4) chemical and biological sensing, and (5) nanosystem integration. 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 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 2011	FY 2012	FY 2013
Title: Nanomaterials Applied Research	4.714	5.291	4.912
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 (e.g., scale-up of processes and fabrication into woven materials) to enable revolutionary future Soldier capabilities.			
FY 2011 Accomplishments: Researched novel materials and hybridization of materials for personnel protection in ballistic environments.			
FY 2012 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H7G: *NANOMATERIALS APPLIED RESEARCH*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Investigate the incorporation of nanoparticles, nanotubes and nanofibers into materials systems to produce novel sensing capabilities for enhanced situational awareness. ***FY 2013 Plans:*** Will design novel sensor and imaging devices based on carbon nanotube, quantum dot, and photonic crystal technologies; and scale-up nanometallic aluminum alloy processing to characterize performance as potential ballistic protective materials.			
Accomplishments/Planned Programs Subtotals	4.714	5.291	4.912

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H84: *MATERIALS*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H84: *MATERIALS*	24.016	24.920	24.129	-	24.129	21.603	23.268	23.313	23.448	Continuing	Continuing

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 Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Title: Structural Armor	5.613	6.960	4.363
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 2011 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H84: *MATERIALS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Determined candidate materials and configurations for ceramic only transparent armor solutions; and characterized materials properties and microstructures to determine optimal configurations for ballistic protection. ***FY 2012 Plans:*** Develop and validate model capability for composite materials that includes high rate effects, thermal effects and fatigue; characterize the high rate properties of structural adhesives and synthesize novel adhesive compositions for inclusion in emerging armor solutions. ***FY 2013 Plans:*** Will investigate novel mechanical deformation processing of magnesium alloy plates that potentially provide very lightweight metal structural materials; provide corrosion mapping for promising aluminum and magnesium alloys and investigate corrosion inhibitors to enable the alloys use for future applications; document materials properties information (such as adhesive strength) for an adhesive database to be used in close collaboration with manufacturers and research universities; fabricate novel boron sub-oxide ceramic materials for use in protection applications; and validate 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.			
Title: Soldier-Borne Armor Materials ***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 2011 Accomplishments:*** Developed new, mass-efficient, protection materials and technologies to mitigate energy from both ballistic and blast events. ***FY 2012 Plans:*** Provide the capability to non-destructively characterize the relationship between ceramic tile quality and ballistic performance; and validate the synthesis of rate dependent soft material tissue surrogates for the development and characterization of personnel armor concepts. ***FY 2013 Plans:*** Will investigate novel materials such as three-dimensional ceramics and fabrics to provide breakthrough technologies for protecting the dismounted soldier under ballistic and blast conditions based on human tissue response data; design novel hybrid material systems with associated processing science to provide lighter, more flexible, more durable and affordable protection to	3.122	2.759	3.252

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H84: *MATERIALS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Soldiers and vehicles; transition fabric ballistic modeling tools to armor designers at Natick Soldier Research, Development, and Engineering Center and Tank and Automotive Research, Development, and Engineering Center.			
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 2011 Accomplishments:*** Established a complete set of parameters that will lead to adiabatic (no heat given off or absorbed) shear behavior of fully dense pure metals; and developed a scaled processing approach for fully dense pure metals and produced samples of sufficient size to permit sub-scale ballistic evaluation. ***FY 2012 Plans:*** Develop cold spray techniques to successfully deposit novel material compositions in confined spaces; validate methods for the composite cladding of advanced gun barrel designs; and validate improvements in gun barrel erosion. ***FY 2013 Plans:*** Will evaluate composite cladding for reduced gun barrel erosion and transition to the Armaments Research, Development, and Engineering Center; demonstrate ordered structures in various media for active and passive wave mitigation and pulsation management for blast applications and acoustic damping.	4.333	3.916	3.000
Title: Electronic Materials ***Description:*** Design and optimize electro-ceramic materials and processing techniques for integration by the Communications-Electronics Research, Development, and Engineering Command (CERDEC) into advanced antennas that will enable affordable and reliable command, control and communications (C3) for current and future force platforms. ***FY 2011 Accomplishments:*** Advanced optimization methodologies to enable low defect synthesis of ferroelectric oxide thin film materials; and performed optimization of low temperature synthesis of ferroelectric oxide thin film materials for Complementary Metal Oxide Semiconductor (CMOS) compatibility and integration. ***FY 2012 Plans:***	0.500	0.514	-

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H84: *MATERIALS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Develop the material designs, fabrication methods, and process science protocols required for CERDEC to achieve high quality, affordable, performance consistent, tunable beam steering antenna elements.			
Title: Nanomaterials ***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 project H7G. ***FY 2011 Accomplishments:*** Developed new reactive structural material compositions and optimized microstructures based on models and experiments; and characterized nanoscale structures using analytical microscopy tools. ***FY 2012 Plans:*** Validate nanograined metallic structures fabrication process using thermodynamic techniques, and provide an initial validation of the improvement in the ballistic capability of transparent materials reinforced with natural cellulose nanofibers. ***FY 2013 Plans:*** Will design synthetic, strain rate dependent polymers to mimic human body tissue; design and evaluate blast resistant cellular topologies using bio-inspired computational algorithms; demonstrate transparent, nano-architectured cellulose based composite materials; and investigate nano-tungsten materials to evaluate engineering properties for ballistic launch survivability.	1.486	1.544	1.736
Title: Multifunctional Armor Materials ***Description:*** This effort researches novel multifunctional armor materials for Army applications such as structural energy storage, armor embedded 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 2011 Accomplishments:*** Performed failure mode characterization of passive and active armor materials; determined propagation fracture toughness in ceramics; measured and modeled residual stress in metal matrix composite armor materials; developed scale up processes for multi-modal materials microstructures; and examined novel metallic structures to reduce weight and manage ballistic impact loads. ***FY 2012 Plans:***	8.962	9.227	11.778

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602105A: *MATERIALS TECHNOLOGY*	PROJECT H84: *MATERIALS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Provide new multifunctional composite materials with structural and power storage capability; develop synthesis routes for soft polymer nano-composites with controllable electrical properties; and provide composite materials with improved damage tolerance for use in ultra-lightweight structures and armors. ***FY 2013 Plans:*** Will design, synthesize, and characterize fiber materials based on biological material mechanics; transition new self-healing technologies to composite fabricators to enhance materials durability; create analytical models to design battery storage composites that can be used in future multifunctional structural composite materials that provide structure and energy storage; investigate improvements in resins, reinforcements, electrodes, and processing techniques to fabricate relevant-size structural capacitors for future multifunctional structural composite materials.			
Accomplishments/Planned Programs Subtotals	24.016	24.920	24.129

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.