Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army											Date: May 2017	
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 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	67.806	31.533	29.640	-	29.640	29.120	29.941	30.862	31.186	-	-
H7B: *Advanced Materials Initiatives (CA)*	-	40.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-
H7G: *Nanomaterials Applied Research*	-	3.551	3.454	3.107	-	3.107	0.000	0.000	0.000	0.000	-	-
H84: *Materials*	-	24.255	28.079	26.533	-	26.533	29.120	29.941	30.862	31.186	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) conducts fundamental research relevant to the Soldier focused on new materials, properties and phenomena in four research areas: (1) lightweight materials and hybrid assemblies for enhanced expeditionary operations, (2) materials and mechanisms that mitigate effects from blast and ballistic threats, (3) materials for augmented soldier protection and situational awareness, and (4) multifunctional materials with integrated structure, power storage, communications, sensing,and/or propulsion to provide system level efficiencies. This project funds collaborative applied research and integration of government, academic, and industry scientific research to advance innovative capabilities.

This PE sustains Army science and technology efforts supporting the Soldier/Squad portfolio.

Work in this PE builds on the materials research transitioned from PE 0601102A and 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 PE is performed by the Army Research Laboratory (ARL), Adelphi, MD and Aberdeen Proving Ground, MD and the Massachusetts Institute of Technology, and the Institute for Soldier Nanotechnologies (ISN) industrial partners through Fiscal Year (FY) 2017.

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army					Date: May 2017
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*		
B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	68.314	31.533	31.849	-	31.849
Current President's Budget	67.806	31.533	29.640	-	29.640
Total Adjustments	-0.508	0.000	-2.209	-	-2.209
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.508	-			
• Adjustments to Budget Years	0.000	0.000	-2.315	-	-2.315
• Civ Pay Adjustments	0.000	0.000	0.106	-	0.106

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: H7B: *Advanced Materials Initiatives (CA)*		
Congressional Add: *Program Increase*	35.000	-
Congressional Add: *High Performance Polymers Research*	5.000	-
Congressional Add Subtotals for Project: H7B	40.000	-
Congressional Add Totals for all Projects	40.000	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
H7B: *Advanced Materials Initiatives (CA)*	-	40.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Advanced Materials Initiatives.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Program Increase ***FY 2016 Accomplishments:*** This is a Congressional Interest Item.	35.000	-
Congressional Add: High Performance Polymers Research ***FY 2016 Accomplishments:*** This is a Congressional Interest Item	5.000	-
Congressional Adds Subtotals	40.000	-

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: FY 2018 Army			Date: May 2017
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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
H7G: *Nanomaterials Applied Research*	-	3.551	3.454	3.107	-	3.107	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

This Project 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 Program Element (PE) 0601104A/project J12 (Institute for Soldier Nanotechnologies (ISN)) to advance innovative capabilities.

This Project sustains Army Science and Technology efforts supporting the Soldier/Squad 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, AND the Massachusetts Institute of Technology, and the ISN industrial partners.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Nanomaterials Applied Research	3.551	3.454	-
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 2016 Accomplishments: Developed nano-structured protective materials and associated processing capabilities to enable novel light-weight materials solutions with enhanced impact performance; and developed novel nano-materials that enable sensing and communication platforms through the use and optimization of size-dependent properties (e.g., quantum confinement) for detection and non-traditional communications.			
FY 2017 Plans:			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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 2016	FY 2017	FY 2018
Will develop nano-enabled sensors that provide low cost detection of hazardous substances in a complex environment; and use novel quantum dot technology to develop materials for reconfigurable antenna applications.			
Title: Emerging Materials for Soldier Protection ***Description:*** Identify, exploit, scale-up, and accelerate the transition of promising breakthroughs in materials research, including nanomaterials, biotechnology, multifunctional materials, and processing science research, via collaborative government, academia, and industry to deliver new materials technologies that revolutionize soldier capabilities and enable expeditionary operations. ***FY 2018 Plans:*** Will investigate and down-select promising materials technologies, and will fund research focused on achieving protection materials that enable a 20% reduction in weight relative to current systems.	-	-	3.107
Accomplishments/Planned Programs Subtotals	3.551	3.454	3.107

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: FY 2018 Army			Date: May 2017
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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
H84: *Materials*	-	24.255	28.079	26.533	-	26.533	29.120	29.941	30.862	31.186	-	-

A. Mission Description and Budget Item Justification

This Project designs, fabricates, and evaluates a variety of materials (e.g. 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 Maneuver, Lethality, and Soldier/Squad portfolios.

Work in this Project makes extensive use of high performance computing and experimental validation and builds on research transitioned from Program Element (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 0602105A (Materials Technology), 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 in this Project is conducted by the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Structural Armor Materials	5.207	5.338	3.996
Description: Conduct applied research to design and evaluate lightweight armor materialsand structures, investigate novel processing methodologies for cost effective manufacturing, use existing and emerging modeling and simulation tools to enable formulation of lightweight, frontal, and structural armor materials for current and future platform applications. Explore ground vehicle structural mechanics and dynamics technologies to improve damage tolerance, durability, fatigue-resistance, and dynamic response (shock, vibration, harshness, and damping).			
FY 2016 Accomplishments: Advanced the manufacturing science of magnesium alloys using specific combinations of processing techniques to impart unique structure and achieve large, high performance plates for armor applications; matured development of damage tolerance concepts for thick composites through refinement of novel experimental and simulation strategies that enable material property			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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 2016	FY 2017	FY 2018
and performance optimization through control of processing parameters; investigated multiscale structure-property relationships and construct predictive characterization schemes with an aim to influence manufacturability of preferred properties. ***FY 2017 Plans:*** Will develop enhanced transparent protective materials by determining the role of material composition on ballistic performance of glass, and by establishing new processing science for producing transparent composites; and develop new strategies for modification of surfaces and interfaces in composite and nanocomposite systems to produce enhanced structural and ballistic materials. ***FY 2018 Plans:*** Will establish new processing science to produce transparent composites using material composition to control and optimize ballistic performance; will further mature new methods to modify surfaces and interfaces in composite and nanocomposite systems and produce small scale bulk composites with enhanced structural and ballistic materials.			
Title: Soldier-Borne Armor Materials ***Description:*** Utilizing understanding of defeat mechanisms from PE 0602618A/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 2016 Accomplishments:*** Developed lab-scale processing approaches for boron-based ceramics using dopants and glassy films to achieve dramatic toughness improvements; investigated energy absorption improvements in helmet padding materials; and developed a validated multi-physics model predicting microstructure and residual stress in ultra high molecular weight polyethylene (UHMWPE) composites as a function of process history to enable improvements in material properties through process optimization. ***FY 2017 Plans:*** Will develop methods to produce, characterize, and model layered 2-dimensional polymer and/or graphene composites to explore new protection concepts and will compare to traditional textile based protection; develop improved unidirectional laminates based on UHMWPE using new computational models; and validate multiscale models of protective fabrics that utilize single-fiber and sub-fiber level details to predict mechanical deformation and failure. ***FY 2018 Plans:*** Will explore synthetic scale-up for potential protection system design application; using computational models, will produce and characterize unidirectional laminates; using validation results of multiscale models, will adjust models to improve accuracy of deformation and failure predictions.	5.264	6.898	7.042
Title: Lethality Materials Technology	4.413	4.492	3.738

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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 2016	FY 2017	FY 2018
Description: This effort involves applied research to develop innovative materials solutions aimed at achieving leap-ahead increases in lethality and weapons effectiveness through dramatic improvements in weight and volume efficiency, lethal effects, and sustainability of military systems that can only be achieved through advances in materials technology. ***FY 2016 Accomplishments:*** Advanced understanding of metal-based gun barrel materials by establishing wear properties and exploring active cooling technologies; determined properties and liner performance of nanostructured copper-based materials; and investigated alternative lower-cost compositions that will provide improved shape charge jet formation and performance of the liner. ***FY 2017 Plans:*** Will develop new Iron (Fe) based alloys using dispersion of oxides to create ultra-high strength, high toughness, and thermally stable materials for a range of lethality applications; utilize synthesis, characterization, and modeling to develop high energy density polymeric materials for use as energetic binders. ***FY 2018 Plans:*** Will validate iron based alloy and characterize integrity through a lethality application demonstration; will produce prototype high energy density polymeric materials and demonstrate their capability as energetic binders.			
Title: Multifunctional Armor Materials ***Description:*** This effort researches novel multifunctional armor materials and associated processing science aimed at enabling critical Army applications in survivability and sustainment. Research efforts include multifunctional protective films and coatings, joining of dissimilar materials, and additive manufacturing of multifunctional materials. Soldier personnel protection materials transition to PE 0602786A/project H98. Vehicle armor materials transition to PE 0602618A/project H80 and PE 0602601A/project C05 ***FY 2016 Accomplishments:*** Matured the additive manufacturing and processing of multi-component materials and developed a new simulation tool that links process science to the desired materials structure and properties; investigated the use of electromagnetic (EM) fields to control and optimize microstructure in metals and ceramics used in armor applications; assessed the formation of ceramic materials through the use of low temperature solidification processing using locally sourced materials; and investigated and characterized peptides (that act as glue in natural/biological materials in warm moist environments) with a goal of demonstrating triple the lifetime and strength in high humidity conditions. ***FY 2017 Plans:*** Will enhance computational capabilities to link additive manufacturing process science to the desired materials structure and properties while further expanding additive manufacturing capabilities; expand investigations in electromagnetic (EM) fields	7.436	9.356	9.697

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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 2016	FY 2017	FY 2018
applications during processing of metals and ceramics to enable new abilities to control and optimize microstructures and develop new low temperature, low pressure processing methods; develop process modeling tools and related experimental capabilities to capture effects of EM fields during ceramic sintering and the resulting structure-property relationships. ***FY 2018 Plans:*** Will use newly enhanced computational capabilities that link additive manufacturing processes to desired structure and properties to produce small scale material; will identify specific electromagnetic processes to control specific microstructures to produce materials with optimized microstructures and desired properties using low temperature, low pressure electromagnetic processes; will use modeling tools to further design and mature ceramics exhibiting desired, predicted structures and properties.			
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 PE 062105A (Materials Technology) / Project H7G (Nanomaterials Applied Research). ***FY 2016 Accomplishments:*** Developed nanocellulose-based fibers with surface modifications for improved toughness and demonstrated improved impact strength in nanocellulose composites; investigated scaled-up fabrication of thermally stable iron-based nanomaterials with enhanced strength and ductility; and determined performance capabilities of nanostructure copper-based shaped charge liners. ***FY 2017 Plans:*** Will synthesize novel small molecules and utilize nanostructured additives and other nanomaterials to develop new hybrid and multifunctional polymer coatings, composites, and films with enhanced dielectric and electromagnetic properties to enable new active / adaptive armor and weapons concepts. ***FY 2018 Plans:*** Will produce bulk material for active/adaptive armor and/or weapon material from newly developed hybrid, multifunctional polymer coatings, composites, and films with enhanced dielectric and electromagnetic properties.	1.935	1.995	2.060
Accomplishments/Planned Programs Subtotals	24.255	28.079	26.533

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602105A / *Materials Technology*	**Project (Number/Name)** H84 / *Materials*

E. Performance Metrics

N/A