PE NUMBER: 0602102F
PE TITLE: Materials

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2004

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

	Cost ($ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	105.237	109.222	73.660	71.548	77.516	80.112	77.598	0.000	0.000
4347	Materials for Structures, Propulsion, and Subsystems	65.429	64.131	41.057	40.876	45.924	47.644	44.371	0.000	0.000
4348	Materials for Electronics, Optics, and Survivability	18.253	19.252	12.437	11.716	12.080	12.444	12.728	0.000	0.000
4349	Materials Technology for Sustainment	16.933	16.204	17.825	16.562	17.054	17.503	17.916	0.000	0.000
4915	Deployed Air Base Technology	3.367	9.635	2.341	2.394	2.458	2.521	2.583	0.000	0.000
5015	Rocket Materials Technology	1.255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: In FY 2003, space unique tasks in Projects 4347 and 4348 were transferred to PE 0602500F, Project 5025, Space Materials Development, as a result of the Space Commission recommendation to consolidate all space unique activities. In FY 2004, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems and operations. The program has four projects that develop: (1) structural, propulsion, and sub-systems materials and processes technologies; (2) electronic, optical, and survivability materials and processes technologies; (3) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (4) air base operations technologies including deployable base infrastructure, force protection, and and fire fighting capabilities. Note: In FY 2004, Congress added $1.5 million for Composite Fire Safety Consortium, $2.6 million for Advanced Wide Bandgap Materials, $1.0 million for Computational Tools for Material Development, $1.7 million for Gallium Nitride Microelectronics and Material Development, $2.4 million for Tyndall Air Force Research Laboratory Research and Development, $1.0 million for Discontinuous Titanium Matrix Composites for Aerospace Applications, $4.0 million for Wright Brothers Institute - Nanostructured Materials for Advanced Air Force Concepts, $2.9 million for Titanium Matrix Composites Program, $1.4 million for Closed Cell Foam Material, $2.8 million for Ultraviolet Free Electron Laser (UV FEL) Capabilities for Aerospace Microfabrication, $10.0 million for Strategic Partnership for Research in Nanotechnology (SPRING), $1.2 million for Durable Hybrid Coatings for Aircraft Systems, $2.3 million for Thermal Sprays for Structural Protection, $1.0 million for Nanotechnology Research, $4.2 million for Microfabrication, and $1.5 million for Composite Materials for Unmanned Air Vehicles (UAV) Initiative.

This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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(U) B. Program Change Summary ($ in Millions)

		FY 2003	FY 2004	FY 2005
(U)	Previous President's Budget	106.955	68.657	68.283
(U)	Current PBR/President's Budget	105.237	109.222	73.660
(U)	Total Adjustments	-1.718	40.565	
(U)	Congressional Program Reductions			
	Congressional Rescissions		-0.935	
	Congressional Increases		41.500	
	Reprogrammings			
	SBIR/STTR Transfer	-1.718		
(U)	Significant Program Changes:			
	Not Applicable.			

Exhibit R-2a, RDT&E Project Justification			DATE February 2004
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4347 Materials for Structures, Propulsion, and Subsystems	

Cost ($ in Millions)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
4347	Materials for Structures, Propulsion, and Subsystems	65.429	64.131	41.057	40.876	45.924	47.644	44.371	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2003, space unique tasks in Project 4347 were transferred to PE 0602500F, Project 5025, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for aircraft and missiles to improve affordability, maintainability, and performance of current and future Air Force systems. A family of affordable lightweight materials is being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide upgraded capabilities for existing aircraft, missile, and propulsion systems to meet the future system requirements. Develops high-temperature turbine engine materials that will enable engine designs to double the turbine engine thrust to weight ratio. Advanced high temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet aerospace and missile requirements. Alternative or replacement materials are being developed to maintain the performance of aging operational systems. Friction and wear-resistant materials, paints, coatings, and other pervasive nonstructural materials technologies are being developed for propulsion and subsystems on aircraft, spacecraft, and missiles. Concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Develop ceramics and ceramic matrix composite technologies for revolutionary performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures.	3.208	4.721	4.733

(U) In FY 2003: Tested advanced ceramic composites for exhaust and hot section components under real and simulated service life conditions, using the data for durability assessment and life prediction development. Developed highly durable thermal protection materials for aerospace vehicles with aircraft-like operability through hot acoustic and other specialized testing. Developed laboratory-scale radar absorbing material coating repair for superalloy and/or titanium alloy substrates. Evaluated more durable ceramic composites based on emerging fibers and advanced interface coatings.

(U) In FY 2004: Design new advanced ceramics and ceramic composites with improved durability and fracture resistance for aircraft applications. Develop advanced analytical techniques to predict the life of advanced ceramic composites containing stress concentration sites. Develop advanced analytical models to design integrally woven, actively cooled ceramic composite structures for advanced combustor applications. Design advanced ceramic composites for severe environments using the best available fiber-matrix interface technology.

(U) In FY 2005: Develop damage resistant advanced ceramic composites for high friction and fracture-prone environments. Test tip rub tolerant concepts for ceramic blades. Update the advanced ceramic composites life

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prediction model to permit prediction of its durability under stress gradients, temperature gradients, and long-term thermal exposure. Fabricate and test integrally cooled ceramic composite sub-elements and small components. Develop laboratory-scale advanced fiber-matrix interface concepts, optimizing on the robustness of these state-of-the-art ceramic composites in severe environments.

(U)

(U) MAJOR THRUST: Develop materials processing technologies involving process models, advanced control methods, and advanced non-invasive sensors. 2.000 2.470 2.731

(U) In FY 2003: Investigated the feasibility of using evanescent microwave or inelastic photon (Raman) imaging of the surface and near-surface region as a process sensor. Evaluated new techniques for generating large-scale dynamic and phase behavior simulations for nanomaterial process design. Transitioned an interactive design-manufacturing environment, which allows rapid design interaction between multiple sites over the Internet. Tested a high-power, tunable laser processing tool for micro-engineered aerospace components and subsystems.

(U) In FY 2004: Evaluate the use of evanescent microwave sensors for evaluating laser damage and subsurface corrosion. Establish baseline parameters for selected techniques for generating large-scale dynamic and phase behavior simulations for nanomaterial process design. Investigate process control of optical deposition for scale-up and stress control of optical and multi-functional coatings for transfer to industry. Initiate studies of processing relationships to produce variation in composites. Investigate nucleation and growth mechanism for single wall carbon nanotubes in order to optimize manufacturing ability.

(U) In FY 2005: Evaluate Raman imaging as an in situ process sensor for processing of nanoscale structural materials. Initiate validation process for large-scale dynamic and phase behavior simulations for nanoparticle processing. Continue investigation and evaluation of process control of optical deposition for scale-up and stress control of optical and multi-functional coatings. Continue investigation of variability in composites for enhanced control and commercial transition. Continue exploration of carbon nanotube growth for commercial scalability.

(U)

(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop enabling polymeric materials for diverse aerospace structural applications including enhanced aircraft canopies, micromechanical devices, advanced wiring concepts, and improved low-observable platforms. Note: In FY 2003, this effort includes Congressional Adds of $6.0 million for Strategic Partnership for Nanotechnology Research and $1.0 million for Closed Cell Foam Material. In FY 2004, this effort includes Congressional Adds of $4.2 million for Microfabrication, $1.0 million for Nanotechnology Research, and $10.0 million for Strategic Partnership for Research in Nanotechnology (SPRING). 9.407 18.025 3.276

(U) In FY 2003: Confirmed feasibility of nanostructured materials for temperature-resistant applications and evaluated applicability for gas and fluid containment components for pervasive Air Force aerospace subcomponent applications. Tested new methods for rapid fabrication of micron-scale three-dimensional structures for Air Force micromechanical devices. Evaluated the use of hybrid thin wires for Air Force aerospace component applications. Demonstrated

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light-absorbing polymeric materials for incorporation into sensor protection and other applications. Investigated new methods for room temperature cure of resins for advanced Air Force composite applications. Evaluated the use of conductive materials for low-observable gap sealants in Air Force aircraft applications.

(U) In FY 2004: Test clay infiltrated nanostructured polymeric materials for impermeability of gas and fluids. Develop rapid fabrication of nanoscale three-dimensional structures for Air Force conducting, structural, and electromechanical applications. Test hybrid thin wires under rigorous environmental conditions and extreme mechanical stresses. Scale up and complete advanced evaluation of two photon absorbing (TPA) polymer materials for night vision goggle protection. Develop the curing process for and initiate testing of composites containing advanced resins. Develop nanostructured polymer materials for low-observable and electromagnetic interference applications.

(U) In FY 2005: Establish the enhanced performance of nanostructured polymeric materials for gas and fluid containment. Continue to develop techniques and materials for nanoscale architectures to address advanced Air Force conducting, structural, and electromechanical applications. Complete development of a hybrid thin wire making process. Complete development of TPA polymer materials for night vision goggle and sensor protection applications. Test the durability of water borne conductive nanocomposites. Enhance conductive polymeric nanocomposites for use in elimination of secondary conductive coatings for aircraft lighting strike protection. Show the feasibility of lightweight radio frequency polymer substrates for reduced aperture size, conformal radar, and antenna systems.

(U)

(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable, advanced organic matrix composite structural materials and technologies for Air Force systems applications including lightweight structures for aerospace subcomponents and other structures requiring thermal and/or structural management for environmental control. Note: In FY 2003, this effort includes Congressional Adds of $3.25 million for Nanostructured Materials, $1.3 million for Thermal Management for Military Aircraft and Space Structures, $1.25 million for Cost-effective Materials for Unmanned Aerial Vehicles, and $0.5 million for Composite Materials Training Program. In FY 2004, this effort includes Congressional Adds of $1.5 million for Composite Materials for Unmanned Aerial Vehicles (UAV) Initiative and $4.0 million for Wright Brothers Institute - Nanostructured Materials for Advanced Air Force Concepts.	13.690	13.170	9.006

(U) In FY 2003: Developed composite material degradation mechanisms to improve life prediction for aircraft environmental control systems, hot exhaust-washed structures, and engine components. Developed next generation high temperature organic matrix composites for aerospace platforms. Improved the processing and fabrication of novel product foams such as nanomaterials, nanotubes, and carbon foams for lightweight, tough, and affordable structural materials.

(U) In FY 2004: Continue to develop an understanding of degradation mechanisms and life prediction capabilities for aircraft turbine engine and exhaust-washed structures as a function of their environments. Validate materials, processing, and fabrication scale-up of high-temperature organic matrix composites for turbine engines, aircraft and

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high-Mach vehicle applications. Evaluate nanomaterials technologies for multifunctional properties required by military aircraft and satellites. Evaluate innovative carbon materials, such as carbon foams, and processing techniques for aircraft thermal management applications.

(U) In FY 2005: Test life prediction capabilities for high temperature turbine engines and airframe hot structures. Optimize materials and processing scale-up of high temperature organic matrix composites for affordable turbine, aircraft structures, and high-Mach vehicles. Develop materials and processes for nanomaterials as matrix additives and/or high performance composites with tailored and multi-functional capabilities. Test materials and processes at the subcomponent level for improved reliability and performance of thermal management application.

(U)

(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop nonstructural materials for fluids, lubricants, aircraft topcoat and corrosion resistant coatings, and specialty treatments to improve system performance and reduce life cycle costs. Note: In FY 2003, this effort includes Congressional Adds of $1.0 million for Nanostructures Protective Coatings, $2.8 million for Durable Coatings for Aircraft Systems, and $1.0 million for Environmentally Sound Aircraft Coatings. In FY 2004, this effort includes a Congressional Add of $1.2 million for Durable Hybrid Coatings for Aircraft Systems.	11.054	8.095	7.621

(U) In FY 2003: Developed electrically conductive elastomers for use in electrostatic discharge control gap treatments. Developed advanced analytical techniques to predict the optical properties of specialty coatings. Established criteria for permanent corrosion-resistant primer resins and environmentally safe corrosion protection with a 30-year life. Established baseline for nanostructured multi-functional coatings to control friction and wear in extreme environments. Developed surface treatments for friction, stiction, and wear control in micro-devices.

(U) In FY 2004: Formulate the most promising electrically conductive elastomers for specific electrostatic discharge control gap treatments. Continue to develop advanced analytical techniques to predict the optical properties of specialty coatings. Investigate non-chromate surface treatments with advanced performance coatings for aircraft corrosion protection systems. Develop environmentally friendly corrosion protection systems with a 30-year life expectancy. Evaluate nanostructured multi-functional coatings to control friction and wear in extreme environments. Refine candidate surface treatments for friction, stiction, and wear control in micro-devices. Investigate potential status monitoring techniques for hydraulic fluids and related subsystems to extend aircraft life and establish condition-based maintenance procedures. Identify materials technologies suitable for use in secure and/or tamper resistant electronics.

(U) In FY 2005: Fabricate candidate materials for use in electrostatic discharge control gap treatments. Refine the advanced analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Evaluate the non-chromate surface treatments with advanced performance coatings for aircraft corrosion protection systems. Continue to develop environmentally friendly corrosion protection systems with a 30-year life expectancy. Design and develop nanostructured multi-functional coatings to control friction and wear in extreme

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	environments. Fabricate and test surface treatments for friction, stiction, and wear control in micro-devices. Evaluate candidate in situ status monitoring techniques for hydraulic systems to extend aircraft life and establish condition-based criteria for repair or replacement. Evaluate material and/or design-based concepts to provide secure and/or tamper resistant electronics.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable lightweight metallic materials, behavior and life prediction technologies, higher temperature intermetallic alloys, and metals processing technology to enable enhanced performance, lower acquisition costs, increased durability, and improved reliability for Air Force weapon systems. Note: In FY 2003, this effort includes Congressional Adds of $4.4 million for Titanium Matrix Composites and $5.3 million for Metals Affordability Initiative. In FY 2004, this effort includes Congressional Adds of $1.0 million for Discontinuous Titanium Matrix Composites for Aerospace Applications and $2.9 million for Titanium Matrix Composites Program.	26.070	17.650	13.690
(U)	In FY 2003: Transitioned life prediction methodology and surface treatments needed to prevent high cycle fatigue damage in integrally bladed rotors. Developed processing methods for second-generation alloys with the potential of achieving a 300°F temperature capability increase over current turbine blade materials. Developed computational methods for modeling the mechanical properties of specific metallic alloys. Optimized and transitioned advanced affordable process technologies to enable more affordable production of complex structural metal components for Air Force aerospace vehicles.			
(U)	In FY 2004: Initiate development of new life prediction technologies for improving aircraft turbine engine rotor durability in thermal-mechanical fatigue design systems. Continue to develop and analyze second-generation high-temperature structural materials that are nickel- and molybdenum-based for turbine engine applications. Develop computational methods for modeling mechanical properties of metals and alloys and validate these tools so that they can be used to reduce the amount of proof testing required to release metals for final component production. Identify processes and protocols for unitized manufacturing of aerospace components.			
(U)	In FY 2005: Develop reliable life extension capabilities for turbine engine rotors. Evaluate performance of high-temperature structural materials through preliminary certification testing and/or ground based engine rig testing. Develop and mature computational methods of modeling mechanical properties to metal suppliers and vendors to enable cost and schedule savings due to reduced amount of proof and release testing. Evaluate processes and protocols for unitized manufacturing of aerospace components.			
(U)	Total Cost	65.429	64.131	41.057

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(U) C. Other Program Funding Summary ($ in Millions)

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT NUMBER AND TITLE: 4348 Materials for Electronics, Optics, and Survivability	

Cost ($ in Millions)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
4348	Materials for Electronics, Optics, and Survivability	18.253	19.252	12.437	11.716	12.080	12.444	12.728	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2003, space unique tasks in Project 4348 were transferred to PE 0602500F, Project 5025, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This project develops materials technologies for surveillance and situational awareness systems and subsystems for aircraft and missile applications, including sensor, microwave, and infrared detection and countermeasures devices used for targeting, electronic warfare, and active aircraft protection. Materials for protection of aircrews, sensors, and aircraft from laser and high-power microwave directed energy threats are also developed. Electronic and optical materials are being developed to enable surveillance and situational awareness with faster operating speeds, greater tunability, higher power output, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. New materials are being developed to counter the most prominent laser threats and to respond to emerging and agile threat wavelengths without impairing mission effectiveness.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Develop, evaluate, and mature infrared (IR) detector materials and materials processing technologies to enable improved performance, affordability, and operational capability of Air Force surveillance, tracking, targeting, and situational awareness systems.	2.885	0.472	0.500

(U) In FY 2003: Developed the process control required for growth of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Transitioned new processing techniques to improve IR detector materials yield and affordability in small lots. Investigated IR detector materials that provide enhanced real-time tracking capability.

(U) In FY 2004: Validate the military utility of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Exploit validated processing techniques to develop enhanced IR detector materials performance and improve military utility. Show the process control required for growth of complex IR detector materials that require control on an atomic level to structure their detection properties. Investigate potential nano-scale materials solutions for detectors for a broad range of Air Force sensing needs including the detection of chemical threats.

(U) In FY 2005: Continue development of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Validate the materials properties of complex IR detector materials that require control on an atomic level to structure their detection properties. Develop promising innovative nano-scale materials as potential IR materials for a broad range of Air Force sensing needs including the detection of chemical threats.

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(U)				
(U)	MAJOR THRUST: Develop, evaluate, and mature materials technologies to enhance the safety and survivability of aircrews and related assets against heat seeking infrared (IR) missiles and laser threats.	5.240	4.925	5.840
(U)	In FY 2003: Developed growth and processing techniques for large nonlinear crystals for generating higher power mid-IR laser radiation for future IR countermeasures (IRCM). Incorporated promising nonlinear absorbing materials into candidate host materials and tested their performance in the Air Force Optical Limiting Testbed for the protection of personnel eyes, viewing systems, and night vision goggles.			
(U)	In FY 2004: Investigate growth and processing techniques for nonlinear optical crystals including surface coatings and nanostructuring for generating laser radiation with significantly higher energy per pulse for future IRCM. Optimize the performance of promising nonlinear absorbing materials in candidate host materials and test their improved performance in the Air Force Optical Limiting Testbed for the protection of personnel eyes, viewing systems, and night vision goggles.			
(U)	In FY 2005: Develop growth and processing techniques for nonlinear optical crystals including surface processing for generating laser radiation with significantly higher energy per pulse for future IRCM. Characterize the performance of the optimized nonlinear absorbing materials in candidate host materials and document the test results obtained for the protection of personnel eyes, viewing systems, and night vision goggles.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and evaluate materials and process technologies for power generation, power control, and microwave components to provide improved performance, affordability, and operational capability for Air Force surveillance, tracking, targeting, situational awareness, and lethal and non-lethal weapon systems. Note: In FY 2003, this effort includes Congressional Adds of $1.1 million for Advanced Materials Deposition for Semiconductor Nanotechnology, $2.1 million for Free Electron Laser Materials Processing, and $3.4 million for Advanced Wide Bandgap Material Technology. In FY 2004, this effort includes Congressional Adds of $2.6 million for Advanced Wide Bandgap Materials and $1.7 million for Gallium Nitride Microelectronics and Material Development.	9.195	8.300	4.225
(U)	In FY 2003: Evaluated materials and materials processing technologies to enable increased Air Force systems reliability and temperature capability, while reducing power consumption, weight, cost, cooling, complexity, and size. Furthered the development and maturation of materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Began scale-up and assessment of materials and materials process technologies for ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft.			
(U)	In FY 2004: Continue evaluation of materials and materials processing technologies to enable increased Air Force systems reliability and temperature capability, while reducing power consumption, weight, cost, cooling, complexity, and size. Continue development and testing of materials and processes to provide presently unattainable performance			

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	for power control systems, advanced radar, and electronic countermeasures. Complete scale-up and maturation of baseline materials and materials process technologies for ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Explore materials and materials process technologies for Terahertz components to provide the bandwidth required for the next order of magnitude leap in speed of Air Force sensor and communication systems.			
(U)	In FY 2005: Enhance specific baseline materials and materials processing technologies to enable increased Air Force systems reliability and temperature capability, while reducing power consumption, weight, cost, cooling, complexity, and size. Investigate advanced materials and materials processing technologies to provide capabilities beyond those achievable with baseline materials. Optimize and scale-up materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Complete assessment of baseline materials and materials process technologies for ultra-lightweight, ultra-high power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Develop advanced materials and materials process technologies to provide improvements and additional capabilities relative to baseline materials/processes. Develop and analyze materials and materials process technologies for Terahertz components to provide the bandwidth required for the next order of magnitude leap in speed of Air Force sensor and communication systems.			
(U)				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and mature enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensors, viewing systems, and night vision goggles against laser threats. In FY 2004, this effort includes Congressional Adds of $1.0 million for Computational Tools for Material Development and $2.8 million for Ultraviolet Free Electron Laser (UV FEL) Capabilities for Aerospace Microfabrication.	0.933	5.555	1.872
(U)	In FY 2003: Developed liquid crystal materials employed in autonomous tunable filters to block near-infrared (IR) wavelengths. Developed high optical density, multiple wavelength switchable filter stacks.			
(U)	In FY 2004: Validate the performance of liquid crystal materials employed in autonomous tunable filters to block near-IR wavelengths. Fabricate laboratory samples of high optical density, multiple wavelength switchable filter stacks.			
(U)	In FY 2005: Design a representative brassboard protection system in the near-IR wavelengths using liquid crystal-based autonomous tunable filters. Characterize the optical performance of high optical density, multiple wavelength switchable filter stacks.			
(U)	Total Cost	18.253	19.252	12.437

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(U) C. Other Program Funding Summary ($ in Millions)

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603112F, Advanced Materials for Weapon Systems.									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment	

Cost ($ in Millions)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
4349	Materials Technology for Sustainment	16.933	16.204	17.825	16.562	17.054	17.503	17.916	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops materials and materials processing technologies to support operational Air Force mission areas by providing the ability to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing a capability to detect and characterize performance threatening defects, characterizing materials processes and properties necessary for materials transition, and providing quick reaction support and failure analysis to the operational commands and repair centers. Repair techniques and nondestructive inspection/evaluation (NDI/E) methods are developed that are needed for metallic and non-metallic structures, coatings, corrosion control processes, and to support integration of composite structures for aerospace systems. Various NDI/E methods are essential to ensure optimum quality in the design and production of aircraft, propulsion, and missile systems. These NDI/E methods are also essential to monitor and detect the onset of any service-initiated damage and/or deterioration due to aging of operational systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Develop NDI/E technologies to identify and characterize damage in aging aerospace structures, propulsion systems, and complex, low-observable (LO) materials and structures.	4.769	3.386	3.788

(U) In FY 2003: Developed inspection methods for aging aerospace structures and propulsion systems. Evaluated methods to rapidly detect and characterize multi-site damage and cracks in large area, aging structures. Evaluated computer simulations and models of NDI/E technique response, which will enable the development of improved inspections in a virtual environment to permit the depots to rapidly assess the potential of new corrosion and crack detection NDI/E methods. Evaluated NDI/E methods to characterize the LO properties of paints and coatings during and after application. Researched residual stress gradient measurement approaches to identify a new capability for subsurface measurement on shot peened surfaces.

(U) In FY 2004: Improve methods to inspect and maintain the integrity of aging aerospace structures and propulsion systems. Develop electromagnetic methods to rapidly detect and characterize multi-site damage and cracks in large-area, aging structures. Develop computer simulations and models of NDI/E technique response, which will enable the development of improved inspections in a virtual environment to permit the depots to rapidly assess the potential of new corrosion and crack detection NDI/E methods. Evaluate technology concepts for measuring complex electromagnetic material properties beneath dielectric tiles in LO applications. Identify methods to detect and characterize damage in repaired (linear friction welded) advanced engine components. Develop residual stress gradient measurement capability for selected turbine engine materials to increase measurement depth capabilities on shot peened surfaces.

(U) In FY 2005: Evaluate electromagnetic methods to rapidly detect and characterize multi-site damage and cracks in

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4349 Materials Technology for Sustainment**

	large area, aging structures. Evaluate computer simulations and models of NDI/E technique response, which will enable the development of improved inspections in a virtual environment to permit the depots to rapidly assess the potential of new corrosion and crack detection non-destructive inspection/evaluation (NDI/E) methods. Develop sensor technologies for measuring complex electromagnetic material properties beneath dielectric tiles. Continue development of a residual stress gradient measurement capability for selected turbine engine materials for shot peened surfaces.			
(U)				
(U)	MAJOR THRUST: Develop enabling low-observable (LO) requirements technologies to reduce the Air Force maintenance burden.	2.426	3.765	4.047
(U)	In FY 2003: Validated capability for NDI/E point inspection devices and verified repair quality. Developed an integrated LO repair kit that includes conductive gap fillers, radar absorbing material (RAM) repair materials, RAM removal equipment, radar absorbing structure (RAS) repair materials, and NDI/E equipment and software.			
(U)	In FY 2004: Complete development of NDI/E point inspection device capability. Develop a standardized LO repair kit for use on multiple aircraft systems, which will result in standardization of aircraft repair processes that includes conductive gap fillers, RAM repair materials, RAM removal equipment, RAS repair materials, and NDI/E equipment and software.			
(U)	In FY 2005: Optimize technologies for an integrated, standardized LO repair kit that includes conductive gap fillers, RAM repair materials, RAM removal equipment, RAS repair materials, and NDI/E equipment and software.			
(U)				
(U)	MAJOR THRUST: Develop support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components.	3.833	3.681	4.040
(U)	In FY 2003: Performed failure analysis and materials investigations for field, acquisition, and depot organizations. Certified and transitioned emerging electrostatic discharge protection materials technologies and techniques for LO applications. Evaluated testing techniques needed for analyzing structural failures of replacement materials for aging Air Force systems.			
(U)	In FY 2004: Continue performing failure analysis and materials investigations for field, acquisition, and depot organizations. Develop electrostatic discharge protection technologies for emerging avionics subsystems. Develop new test methodologies for analyzing structural failures of replacement materials for aging Air Force systems. Investigate materials technologies effort to replace aging wiring in Air Force aircraft subsystems.			
(U)	In FY 2005: Continue performing failure analysis and materials investigations for field, acquisition, and depot organizations. Validate electrostatic discharge protection technologies for emerging avionics sub-systems. Validate new test methodologies for analyzing structural failures of replacement materials for aging Air Force systems. Develop materials technologies effort to replace aging wiring in Air Force aircraft subsystems.			
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602102F Materials**	PROJECT NUMBER AND TITLE **4349 Materials Technology for Sustainment**

(U)	MAJOR THRUST: Develop support capabilities, information, and processes to resolve problems in the use of materials in the repair of aircraft structures and to reduce aircraft corrosion.	5.905	5.372	5.950
(U)	In FY 2003: Published residual stresses baseline criteria of high cycle fatigue foreign object damage in turbine engine blade materials. Transitioned advanced composite materials compatibility with laser effluents as an alternative to metallic materials for high-energy chemical oxygen-iodine laser devices. Established capabilities to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Published baseline for improved corrosion management procedures.			
(U)	In FY 2004: Develop and evaluate methodologies to determine corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Identify failure mechanisms in Micro-Electro-Mechanical Systems (MEMS) used in hybrid, multifunctional, or status monitoring structures and subsystems.			
(U)	In FY 2005: Mature methodologies to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Evaluate methodologies to test failure limits for MEMS Structures and subsystems.			
(U)	Total Cost	16.933	16.204	17.825

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603112F, Advanced Materials for Weapons Systems.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2004
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602102F Materials		PROJECT NUMBER AND TITLE: 4915 Deployed Air Base Technology

Cost ($ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
4915 Deployed Air Base Technology	3.367	9.635	2.341	2.394	2.458	2.521	2.583	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project supports the Aerospace Expeditionary Forces (AEF) through development of new technologies for deployable airbase systems to reduce airlift and manpower requirements, setup times, and sustainment costs, and to improve protection and survivability of deployed AEF warfighters. Efficient and cost-effective technologies are developed for base infrastructure, fire fighting, and force protection to improve deployed operations.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Developed affordable, deployable technologies to ensure military readiness, maintain aerospace missions, support weapon systems sustainment, and ensure deployablity. Enhanced development of safe, cost-effective disposal of problem AEF wastes for low-observable material waste treatment. Note: In FY 2004, remaining activities in this thrust will be integrated into the other major thrusts in this project.	0.101	0.000	0.000
(U) In FY 2003: Developed affordable, deployable technologies to ensure military readiness, maintain aerospace missions, support weapon systems sustainment, and ensure deployablity. Developed safe, cost-effective disposal of problem AEF wastes for low-observable material waste treatment.			
(U) In FY 2004: Not Applicable.			
(U) In FY 2005: Not Applicable.			
(U)			
(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations. Note: In FY 2003, this effort includes a Congressional Add of $1.2 million for Tyndall Air Force Research Laboratory. In FY 2004, this effort includes half of a Congressional Add of $2.4 million for Tyndall Air Force Research Laboratory Research and Development.	1.794	2.240	1.173
(U) In FY 2003: Developed deployable fuel cell, solar power, and heat pump technologies that increase performance, decrease maintenance, increase mean time between failure, increase operating efficiency, and reduce sustainment costs.			
(U) In FY 2004: Mature deployable fuel cell power system to advanced technology development. Continue development of high-efficiency solid state solar cell technology. Initiate development of an advanced, compact integrated shelter/utility system that will integrate fuel cell and solar power with heat pump technologies to provide highly efficient, individual systems for deployable shelters. Initiate research on polymer-clay stabilization technology for rapid airfield expansion that will reduce the time required to prepare aircraft operating surfaces at contingency bases. Initiate research on catalysis and degradation of Air Force materials that will provide cleaner and lower cost advanced			

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4915 Deployed Air Base Technology

materials.

(U) In FY 2005: Develop high-efficiency solid state solar cell technology. Develop advanced integrated shelter power/Heating, Ventilation, and Air Conditioning concepts that will integrate fuel cell, solar and heat pump technologies into a highly efficient compact system that can provide total energy and air conditioning requirements for individual deployable shelters. Develop polymer-clay stabilization agents for rapid airfield expansion that will reduce time to prepare aircraft operating surfaces at unimproved contingency bases. Evaluate catalysis and degradation technologies of Air Force materials that will provide cleaner, lower cost advanced materials.

(U)

(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop cost-effective technologies to provide force protection and survivability to Aerospace Expeditionary Forces (AEF) deployed warfighters and infrastructure. Note: In FY 2004, this effort includes Congressional Adds of $1.4 million for Closed Cell Foam Materials, $1.5 million for Composite Fire Safety Consortium, $2.3 million for Thermal Sprays for Structural Protection, and half of $2.4 million for Tyndall Air Force Research Laboratory Research and Development.	1.472	7.395	1.168
(U) In FY 2003: Developed atmospheric threat prediction models and deployable sensors systems to protect AEF personnel from toxic industrial materials. Developed effective advanced fire fighting agents and equipment and advanced blast protection materials to protect deployed warfighters.			
(U) In FY 2004: Continue development of fire fighting foam agents in conjunction with combined fire suppressant equipment and advanced blast protection materials to protect deployed warfighters. Develop and evaluate polymer-based retrofit technologies for expeditionary and permanent structures to protect the warfighter.			
(U) In FY 2005: Develop effective advanced fire fighting agents and equipment and advanced blast protection materials to protect deployed warfighters. Initiate research on chemical laser fire suppression agents for effective protection of laser weapons systems. Initiate research on resilient infrastructure technologies for more effective protection of structures and inhabitants.			
(U) Total Cost	3.367	9.635	2.341

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
(U) Related Activities:									
(U) PE 0603112F, Advanced Materials for Weapon Systems. This project has been coordinated through the Reliance process to harmonize efforts and eliminate									

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4915 Deployed Air Base Technology

(U) C. Other Program Funding Summary ($ in Millions)

duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2004

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT NUMBER AND TITLE: 5015 Rocket Materials Technology

Cost ($ in Millions)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total
5015 Rocket Materials Technology	1.255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2003, civilian salaries associated with space unique tasks in PE 0602102 were transferred to Project 5015. In FY 2004, these salaries in Project 5015 will be transferred to PE 0602500F, Project 5025, as a result of the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description and Budget Item Justification

This project develops advanced pervasive materials and processing technologies for aerospace propulsion technologies to dramatically improve affordability, performance, and reliability of current and future aerospace engine applications. The components of liquid-fuel engines that advanced materials can significantly impact include lightweight ducts, turbo pumps, injectors, and nozzles sub-systems. The material advancements in these aerospace systems will provide lighter weight, performance, and cost-reduction enhancements for overall aerospace engine applications. This project will develop material property databases and initiate the demonstration of suitability for new materials application using representative geometry and processing conditions for the intended aerospace engine components.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2003	FY 2004	FY 2005
(U) MAJOR THRUST: Develop and evaluate pervasive materials and processing technologies for aerospace engine components and sub-components to dramatically improve affordability, performance, and reliability of current and future Air Force aerospace systems.	1.255	0.000	0.000
(U) In FY 2003: Evaluated chemistry/heat treatment combination for new compatible alloys for aerospace propulsion housing components. Identified and developed pervasive zero erosion materials for multiple aerospace engine and missile applications. Identified and evaluated pervasive high temperature catalyst materials that will enable the use of high performance monopropellants for aerospace propulsion systems.			
(U) In FY 2004: Not Applicable.			
(U) In FY 2005: Not Applicable.			
(U) Total Cost	1.255	0.000	0.000

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost

(U) Related Activities:
PE 0602203F, Aerospace Propulsion.
(U) PE 0603112F, Advanced Materials for Weapon Systems.
PE 0602500F,

Exhibit R-2a, RDT&E Project Justification		DATE February 2004
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 5015 Rocket Materials Technology

(U) C. Other Program Funding Summary ($ in Millions)

(U) Multi-Disciplinary Space Technology. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.