RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 2002

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

	COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	91,975	97,989	75,272	77,104	78,329	79,204	82,135	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	62,036	61,777	40,907	42,634	42,701	43,104	45,036	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	9,932	14,950	12,616	12,707	13,033	13,158	13,530	Continuing	TBD
4349	Materials Technology for Sustainment	20,007	19,850	18,064	18,089	18,386	18,548	18,991	Continuing	TBD
4915	Deployed Air Base Technology	0	1,412	2,345	2,236	2,515	2,582	2,647	Continuing	TBD
5015	Rocket Materials Technology	0	0	1,340	1,438	1,694	1,812	1,931	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2002, Project 4397 efforts transferred from PE 0602102F into Project 4915, Deployed Air Base Technology. In FY 2003, space unique tasks in Projects 4347 and 4348 will be transferred to PE 0602500F, Project 5025 in conjunction with the Space Commission recommendation to consolidate all space activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into Project 5015, Rocket Materials Technology, from PE 0602203F, Aerospace Propulsion, Project 4847, Rocket Propulsion Technology.

(U) A. Mission Description

The Materials program develops advanced materials and processing technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. The program has four projects which: (1) develop structural, propulsion, and sub-systems materials and processes technologies; (2) develop electronic, optical, and survivability materials and processes technologies; (3) develop sustainment materials and processes technologies; and (4) develop air base operations technologies including power generation, deployable shelters, and fire fighting. Note: In FY 2002, Congress added $3.0 million for the Metals Affordability Initiative, $6.0 million for advanced physical vapor silicon carbide crystal device technology, $2.0 million

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(U) A. Mission Description Continued

for durable hybrid coatings for aircraft systems, $3.4 million for carbon foam development for aircraft and spacecraft, $1.0 million for environmentally sound coatings, $1.7 million for free electron laser, and $4.3 million for titanium matrix composites. This explains the perceived overall decrease in the Materials program in FY 2003 and out.

(U) B. Budget Activity Justification

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.

(U) C. Program Change Summary ($ in Thousands)

		FY 2001	FY 2002	FY 2003	Total Cost
(U)	Previous President's Budget	96,422	77,164	78,037	
(U)	Appropriated Value	97,315	98,564		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions		-575		
	b. Small Business Innovative Research	-2,265			
	c. Omnibus or Other Above Threshold Reprogram	-2,182			
	d. Below Threshold Reprogram				
	e. Rescissions	-893			
(U)	Adjustments to Budget Years Since FY 2002 PBR			-2,765	
(U)	Current Budget Submit/FY 2003 PBR	91,975	97,989	75,272	TBD

(U) Significant Program Changes:

In FY 2003, the decrease in this program is due to the transfer of space unique tasks in conjunction with the Space Commission recommendation to consolidate all space unique activities. Additionally, in FY 2002, this program received Congressional Adds which explains the perceived decrease in FY 2003.

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DATE: February 2002

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4347

COST ($ in Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4347	Materials for Structures, Propulsion, and Subsystems	62,036	61,777	40,907	42,634	42,701	43,104	45,036	Continuing	TBD

Note: In FY 2003, space unique tasks in Project 4347 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

Develops materials and processing technology base for aircraft and missiles to improve affordability, maintainability, and performance of current and future Air Force systems. Advanced thermal 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. A family of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide upgraded capability for existing aircraft, missile, and propulsion systems to meet the future system requirements. Develop high temperature turbine engine materials that will enable engine designs to double the turbine engine thrust to weight ratio. Alternative or replacement materials are developed to maintain the performance of aging operational systems. Friction and wear resistant materials, paints, coatings, and other pervasive nonstructural material technologies are being developed for the subsystems on aircraft, spacecraft, and missile systems as well as their propulsion systems. Concurrent development of advanced processing methods to enable `adaptive' processing of aerospace materials. Note: In FY 2002, Congress added $3.0 million for Metals Affordability Initiative, $2.0 million for durable hybrid coatings for aircraft systems, $3.4 million for carbon foam development for aircraft and spacecraft, $4.3 million for titanium matrix composites, $1.7 million for free electron laser, and $1.0 million for environmentally sound coatings which explains the perceived decrease in FY 2003.

(U) FY 2001 ($ in Thousands)

(U) $4,982 Developed enabling polymeric materials technologies for diverse, high-payoff Air Force system needs including structural applications. Evaluated suitable polymers and conductive elastomers as base materials for low-observable gap sealants, thin wires, and electrostatic discharge coatings. Evaluated toughened and nanostructured polymers for thin films to enable inflatable membrane structures such as deployable mirrors for surveillance and space counterforce applications. Developed new methods for rapid fabrication of nanometer to micron three-dimensional structures and rapid composite repair.

(U) $10,064 Developed and transitioned nonstructural materials technology base for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treatments to improve system performance and reduce life cycle costs. Developed advanced lubricant materials for high-speed bearing and rotating components (gyroscopes) in spacecraft and fabricate optically tailorable thermal control coatings with controlled

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

emissivity for spacecraft thermal control. Validated feasibility of electrically conductive elastomers for use in low-observable gap treatments and develop analytical techniques to predict the optical properties of specialty coatings. Developed permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life for aircraft platforms.

(U) $18,282 Developed affordable, advanced organic matrix composite structural materials and technologies for Air Force systems applications including lightweight structures (airframes, control surfaces, trusses, struts, engine components, substructures), space vehicles tanks, space vehicle bus structures, radiators, and other structures requiring thermal and/or structural management for environmental control. Validated processing and/or mechanics models which predict component dimensions and decrease the amount of shimming, rework, and fit up for large integrated structures for future Air Force air platforms. Developed composite material degradation mechanisms to improve life prediction for aircraft environmental control systems and hot, exhaust-washed structures and engine components. Validated non-autoclave processes for large structural, cryogenics tanks, and substructures for future Air Force space platforms and develop materials and process for low-cost, multifunction composites enabling small, highly tailorable space platforms. Evaluated novel product forms (foams, nanomaterials) for lightweight, tough, and affordable structural materials.

(U) $23,081 Developed and transitioned affordable lightweight metallic materials, behavior and life prediction technology, higher temperature intermetallic alloys, and metals processing technology to enhance performance, lower acquisition cost, increase durability, and improve reliability of Air Force weapon systems. Transitioned wrought gamma titanium aluminides with a 200°F higher temperature capability for demonstration in advanced gas turbine engine critical components. Developed specific molybdenum-based and niobium-based intermetallic alloys with the potential of achieving a 300°F temperature capability increase over turbine blade materials. Developed life prediction and design methods to better predict the impact of high cycle fatigue damage on critical engine components. Developed life prediction methodologies and inspection technologies to extend turbine engine rotor life, establish retirement for cause criteria, and enable repair processes for critical components. Optimized and transitioned process technologies, such as permanent mold casting, laser forming, and roll forming to enable the production of affordable and high quality metallic components. Optimized metallic materials, such as discontinuously reinforced aluminum, nanocrystalline aluminum, and high temperature metallic sheets to produce lightweight, high strength components for space systems and thermal protection for space vehicles.

(U) $5,627 Developed ceramics and ceramic matrix composites technologies for enhanced performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Determined the durability of ceramics under service life conditions to guide further materials development and to assess useable life. Tested integrally woven ceramic composite structures for actively cooled space vehicle applications, develop thermal protection materials with improved durability for emerging reusable space vehicles, and evaluate ceramic

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

composites for space mirror applications. Validated 2400°F material capability for turbine engine combustors and airfoils through extensive coupon and subelement testing, optimize ceramic composites for aircraft brake friction materials, and test durability of reduced cost ceramic composite for exhaust components. Validated repair techniques for radar absorbing material coatings and quantifying the shelf life of the repair constituents. Validated advanced constituent, oxidation resistant, interface coatings through fiber and composite testing.

(U) $62,036 Total

(U) FY 2002 ($ in Thousands)

(U) $8,126 Develop enabling polymeric materials for diverse aerospace structural applications including spacecraft mirror applications, enhanced aircraft canopies, micromechanical devices, and advanced wiring concepts. Evaluate toughened and nanostructured polymers as temperature resistant in Air Force aircraft and space applications. Demonstrate and verify new methods for rapid fabrication of micron three-dimensional structures for Air Force micromechanical devices. Demonstrate use of hybrid thin wires for aircraft and spacecraft applications. Investigate feasibility of flexible, higher efficiency polymeric fibers for photovoltaic advanced solar cells. Optimize light-absorbing polymeric materials for incorporation into paint formulations for corrosion characterization applications.

(U) $14,086 Develop affordable, advanced organic matrix composite structural materials and technologies for Air Force systems applications including lightweight structures requiring thermal and/or structural management for environmental control. Scale-up and publish demonstrated processing and/or mechanics models which predict component dimensions improving low-observable and affordability for large integrated structures for future Air Force air platforms. Investigate specific composite material degradation mechanisms to improve life prediction for aircraft environmental control systems and hot, exhaust-washed structures and engine components. Evaluate next generation high temperature organic matrix composites for air and space platforms. Evaluate non-autoclave materials and processes for composite cryogenic tank structures for future space platforms. Process and fabricate novel product foams such as nanomaterials, nanotubes, and carbon foams for lightweight, tough, and affordable structural materials.

(U) $10,875 Develop and transition nonstructural materials for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treatments to improve system performance and reduce life cycle costs. Test optically tailorable thermal control coatings with controlled heat dissipation for spacecraft thermal control. Evaluate effects of the space environment on polymer and thermal control coatings. Explore electrically conductive elastomers for use in low-observable gap treatments. Establish baseline analytical techniques to predict the optical properties of specialty coatings. Process permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life for aircraft surfaces. Identify nanostructured multifunctional coatings to control friction and wear in extreme operating environments. Evaluate surface

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

treatments for friction, stiction, and wear control in micro-scale devices and micromechanical applications.

(U) $24,578 Develop and transition affordable lightweight metallic materials, behavior and life prediction technologies, higher temperature intermetallic alloys, and metals processing technology to enhance performance, lower acquisition cost, increase durability, and improve reliability for weapon systems. Demonstrate life prediction methodology and surface treatments needed to prevent High Cycle Fatigue damage in integrally bladed rotors. Characterize high temperature metallic alloys with the potential of achieving a 300°F temperature capability increase over current turbine blade materials. Refine damage-tolerant life prediction methodologies for high temperature resistant titanium alloy for their use in fracture-critical turbine engine applications. Develop advanced affordable process technologies to enable more affordable production of complex structural metal components for air and space vehicles. Develop processing methods for the metallic materials for lightweight, high-strength components in future space vehicles.

(U) $4,112 Develop ceramics and ceramic matrix composite technologies for enhanced performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Evaluate ceramic composites for exhaust and hot section components under real and simulated service life conditions, with a focus toward life prediction and durability assessment. Develop highly durable thermal protection materials for aerospace vehicles with aircraft-like operability. Develop ceramic composites for lightweight space mirror applications. Identify best performing aircraft brake material and perform full-scale dynamometer tests. Optimize radar absorbing material coating repair for superalloy and/or titanium alloy substrates. Evaluate advanced oxidation-resistant interface coatings in severe applications. Initiate development of more durable ceramic composites based on these new coatings.

(U) $61,777 Total

(U) FY 2003 ($ in Thousands)

(U) $2,761 Develop enabling polymeric materials for diverse aerospace structural applications including enhanced aircraft canopies, micromechanical devices, advanced wiring concepts, and improved low-observable platforms. Demonstrate feasibility of nanostructured materials for temperature resistent applications and evaluate applicability for gas and fluid containment components for pervasive Air Force aerospace subcomponent applications. Demonstrate and transition new methods for rapid fabrication of micron three-dimensional structures for Air Force micromechanical devices. Demonstrate and transition use of hybrid thin wires for Air Force aerospace component applications. Demonstrate light-absorbing polymeric materials for incorporation into paint formulations for corrosion characterization applications. Investigate new methods for room temperature cure of resins for advanced Air Force composite applications. Evaluate the use of conductive materials for low-observable gap-sealants in Air Force aircraft applications.

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

(U) $8,059 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. Develop composite material degradation mechanisms to improve life prediction for aircraft environmental control systems and hot, exhaust-washed structures and engine components. Develop next generation high temperature organic matrix composites for aerospace platforms. Continue processing and fabrication of novel product foams such as nanomaterials, nanotubes, and carbon foams for lightweight, tough, and affordable structural materials.

(U) $6,802 Develop and transition nonstructural materials for fluids, lubricants, aircraft topcoat and corrosion resistant coatings, and specialty treatments to improve system performance and reduce life cycle costs. Develop electrically conductive elastomers for use in low-observable gap treatments. Develop advanced analytical techniques to predict the optical properties of specialty coatings. Test permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life. Establish baseline for nanostructured multifunctional coatings to control friction and wear in extreme environments. Develop surface treatments for friction, stiction, and wear control in micro devices.

(U) $17,729 Develop and transition affordable lightweight metallic materials, behavior and life prediction technology, higher temperature intermetallic alloys, and metals processing technology to enable enhanced performance, lower acquisition cost, increased durability, and improved reliability for Air Force weapon systems. Transition life prediction methodology and surface treatments needed to prevent High Cycle Fatigue damage in integrally bladed rotors. Develop processing methods for second-generation alloys with the potential of achieving a 300°F temperature capability increase over current turbine blade materials. Develop computational methods for modeling the mechanical properties of specific metallic alloys. Optimize and transition advanced affordable process technologies to enable more affordable production of complex structural metal components for Air Force aerospace vehicles.

(U) $3,421 Develop ceramics and ceramic matrix composites technologies for revolutionary performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Test 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. Demonstrate highly durable thermal protection materials for aerospace vehicles with aircraft-like operability through hot acoustic and other specialized testing. Demonstrate radar absorbing material coating repair for superalloy and/or titanium alloy substrates. Evaluate more durable ceramic composites based on emerging fibers and advanced interface coatings.

(U) $2,135 Develop and transition materials processing technologies involving process models, multi-objective optimization methods, and advanced non-invasive sensors. Investigate the feasibility of using evanescent microwave or inelastic photon (Raman) imaging of the surface and near-surface region as a process sensor. Evaluate new techniques for generating large-scale dynamic and phase behavior simulations for

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
02 - Applied Research	0602102F Materials	4347

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

nanomaterial process design. Transition an interactive design-manufacturing environment which allows rapid design interaction between multiple sites over the internet web.

(U) $40,907 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:
(U) PE 0603112F, Advanced Materials for Weapon Systems
(U) PE 0603211F, Aerospace Systems
(U) PE 0603202F, Aeropropulsion Subsystem Integration.
(U) PE 0603216F, Aeropropulsion and Power Technology
(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.

(U) E. Schedule Profile

(U) Not Applicable.

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BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4348

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4348 Materials for Electronics, Optics, and Survivability	9,932	14,950	12,616	12,707	13,033	13,158	13,530	Continuing	TBD

Note: In FY 2003, space unique tasks in Project 4348 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

Develops materials technologies for surveillance and terrestrial situational awareness systems and subsystems for aircraft and missile applications. Develops materials for protection of aircrews, sensors, and aircraft from laser and high power microwave directed energy threats. Develops sensor modules, microwave devices, infrared detectors, and infrared countermeasures devices are used in target detection, weapons targeting, electronic warfare, and active aircraft protection. Electronic and optical materials are being developed to enable surveillance and terrestrial situational awareness with higher operating speeds, greater tunability, higher output power, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. Materials are being developed to counter the most prominent threat laser wavelengths and new materials are being developed to respond to emerging threat wavelengths and ultimately to reject the directed energy independent of agile threat wavelengths, without impairing mission effectiveness. Note: In FY 2002, Congress added $6.0 million for advanced silicon carbide crystal device tecnology which explains the perceived decrease in FY 2003.

(U) FY 2001 ($ in Thousands)

(U) $4,408 Developed materials and process technologies for power control and microwave devices to provide improved performance, affordability, and operational capability of surveillance and situational awareness systems. Developed materials and materials processes to provide increased reliability and temperature capability while reducing power consumption, weight, cost, cooling, complexity, and size. Developed bulk and epitaxial materials with improved performance at and above the X-band wavelength region to enable improved power control devices. Evaluated sensor materials for defect density, doping, and stoichiometry through advanced process control techniques.

(U) $2,908 Developed enabling infrared (IR) detector materials and process technologies to enable improved performance, affordability, and operational capability of surveillance and situational awareness systems. Evaluated alternative materials to fabricate IR detector focal plane arrays at very long wavelengths. Demonstrated multi-layered and hyperspectral/multi-spectral IR detector materials that respond to combinations of wavelengths within spectral bands and between spectral bands. Developed new processing techniques to improve yield in small lot manufacturing.

(U) $2,006 Developed materials technology to enhance the safety and survivability of aircrews against heat seeking IR missile and laser threats. Developed new nonlinear-optical materials to replace state-of-the-art lithium niobate for infrared countermeasure devices. Demonstrated

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

second generation, nonlinear absorbers as IR materials; designed a gradient limiter device, transition damage tolerant, biological limiter host materials for protection of personnel eyes, viewing systems, and night vision goggles; and established a hardened night vision goggle testbed.

(U) $610 Developed enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensor systems against laser threats. Evaluated liquid crystal materials for autonomous tunable filters to block unknown wavelengths. Evaluated switchable (hologram) narrow notch filters to provide day and night sensor agile jamming protection. Demonstrated dual wavelength, high optical density switchable filter stacks for laser eye protection.

(U) $9,932 Total

(U) FY 2002 ($ in Thousands)

(U) $8,163 Develop and demonstrate materials and process technologies for power generation, power control, and for microwave components to provide improved performance, affordability, and operational capability for surveillance, targeting/tracking, situational awareness, and lethal and non-lethal weapon systems. Develop and demonstrate materials and materials processing technologies to enable increased power generation and power control components reliability and temperature capability while reducing power consumption, weight, cost, cooling, complexity, and size. Develop and demonstrate materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic counter measures systems. Develop 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) $2,408 Develop and demonstrate infrared detector (IR) materials and materials processing technologies to enable improved performance, affordability, and operational capability of surveillance, tracking, targeting, and situational awareness systems. Develop alternative IR detector materials for space applications capable of detecting very long wavelengths. Develop the process control required for growth of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Validate new processing techniques to improve IR detector materials yield and affordability in small lots.

(U) $3,714 Develop and demonstrate materials technology to enhance the safety and survivability of aircrews and related assets against heat seeking missiles and laser threats. Demonstrate improved growth and processing techniques for large nonlinear crystals for generating higher power far-IR laser radiation for advanced infrared countermeasures. Develop and validate materials processing techniques and materials that will enable high performance optical control of phased array radar and satellite to satellite data links. Identify and characterize organic materials with large nonlinear absorption properties for the protection of personnel eyes, viewing systems, and night vision goggles.

(U) $665 Develop enabling materials technologies to enhance the survivability and mission effectiveness of aerospace sensors, viewing systems, and

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

night vision goggles against laser threats. Develop liquid crystal materials for autonomous tunable filters to block agile laser wavelengths. Evaluate high optical density, multiple wavelength switchable filter stacks on curved substrates for agile laser wavelength eye protection.

(U) $14,950 Total

(U) FY 2003 ($ in Thousands)

(U) $2,955 Develop and demonstrate materials and process technologies for power generation, power control, and for microwave components to provide improved performance, affordability, and operational capability for Air Force surveillance, targeting/tracking, situational awareness and lethal and non-lethal weapon systems. Demonstrate and validate 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. Develop and transition materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Scale up and transition 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) $3,077 Develop, demonstrate and transition 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. Demonstrate the process control required for growth of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Transition new processing techniques to improve detector materials yield and affordability in small lots. Investigate IR detector materials that provide enhanced real-time tracking capability.

(U) $5,589 Develop, demonstrate, and transition materials technology to enhance the safety and survivability of aircrews and related assets against heat seeking missiles and laser threats. Develop growth and processing techniques for large nonlinear crystals for generating higher power mid-IR laser radiation for future infrared countermeasures. Incorporate promising nonlinear absorbing materials into candidate host materials and demonstrate their performance in the Air Force Optical Limiting Testbed for the protection of personnel eyes, viewing systems, and night vision goggles.

(U) $995 Develop and transition enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensors, viewing systems, and night vision goggles against laser threats. Demonstrate liquid crystal materials employed in autonomous tunable filters to block near-infrared wavelengths. Develop high optical density, multiple wavelength switchable filter stacks on curved substrates.

(U) $12,616 Total

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(U) B. Project Change Summary

Not Applicable

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

(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 Structures.
(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.

(U) E. Schedule Profile

(U) Not Applicable.

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PROJECT: 4349

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4349 Materials Technology for Sustainment	20,007	19,850	18,064	18,089	18,386	18,548	18,991	Continuing	TBD

(U) A. Mission Description

Develops and transitions 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 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. Develops repair techniques and nondestructive inspection/evaluation (NDI/E) methods 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) FY 2001 ($ in Thousands)

(U) $4,301 Developed and transitioned NDI/E technology to identify and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems. Transitioned enhanced laser-generated ultrasound capabilities to detect the onset of hidden corrosion between metallic structural elements. Initiated development of an NDI/E response computer simulation model for integrated product design. Developed and designed laboratory scale capability to evaluate remote inspection capabilities for crack detection within complex structures. Evaluated methods to nondestructively measure near surface (100 micron) residual stress depth gradients to allow depots to safely extend the service life of turbine engine rotors.

(U) $2,911 Developed and transitioned enabling technologies to reduce the Air Force maintenance burden due to low-observable requirements. Established baseline capability for NDI/E point inspection devices to verify repair quality. Assembled an integrated low-observable repair kit. Demonstrated high temperature and/or ultraviolet gap sealants and conductive elastomers. Developed ultrasonically applied and/or removed thermoplastic radar absorbing material (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs.

(U) $4,627 Developed and transitioned support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components. Performed failure analysis and materials investigations for field, acquisition, and depot organizations. Transitioned electrostatic discharge protection materials technologies for space and low-observable applications. Evaluated testing techniques needed for analyzing structural failures of replacement materials for aging Air Force systems.

(U) $8,168 Developed and transitioned support capabilities, information, and processes to resolve problems in the use of materials, in the repair of aircraft

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

structures, and to reduce aircraft corrosion. Established residual stresses baseline criteria of High Cycle Fatique and foreign object damage in turbine engine blade materials. Evaluated advanced composite materials compatibility with laser effluents as an alternative to metallic materials for high energy chemical oxygen-iodine laser devices. Developed improved gap-filler materials for low-observable platforms and test on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Developed capabilities to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Validated technical understanding of corrosion.

(U) $20,007 Total

(U) FY 2002 ($ in Thousands)

(U) $4,443 Develop non-destructive inspection/evaluation (NDI/E) technology to identify and characterize damage in complex, low-observable materials and structures. Develop inspection technology for aging aerospace structures and propulsion systems. Identify methods to rapidly detect and characterize multi-site damage and cracks in large area, aging structures. Identify 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. Develop transition methods to measure residual stress to allow depots to safely extend the service life of turbine engine rotors. Identify and develop methods to detect and characterize the severity of fretting fatigue in engine components. Identify NDI/E methods to characterize the low-observable properties of paints and coatings during and after application.

(U) $3,128 Develop enabling technologies to reduce the Air Force maintenance burden due to low-observable requirements. Develop capability for NDI/E point inspection devices and verify repair quality. Evaluate an integrated low-observable repair kit. Validate high temperature and/or ultraviolet gap sealants and conductive elastomers. Demonstrate ultrasonically applied and/or removed thermoplastic radar absorbing material (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs.

(U) $4,778 Develop and transition support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components. Perform failure analysis and materials investigations for field, acquisition, and depot organizations. Continue certification and transition of emerging electrostatic discharge protection materials technologies and techniques for space and low-observable applications. Continue experimental evaluation of testing techniques needed for analyzing structural failures of replacement materials for aging Air Force systems.

(U) $7,501 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. Validate residual stresses baseline criteria of high cycle fatigue foreign object damage in turbine engine blade

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

materials. Demonstrate advanced composite materials compatibility with laser effluents as an alternative to metallic materials for high energy chemical oxygen-iodine laser devices. Evaluate improved gap-filler materials for low-observable platforms and test on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Demonstrate capabilities to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Establish baseline for improved corrosion management procedures.

(U) $19,850 Total

(U) FY 2003 ($ in Thousands)

(U) $5,088 Develop non-destructive inspection/evaluation (NDI/E) technology to identify and characterize damage in complex, low-observable (LO) materials and structures. Develop inspection for aging aerospace structures and propulsion systems. Evaluate methods to rapidly detect and characterize multi-site damage and cracks in large area, aging structures. Evaluate computer simulations and models of non-destructive evaluation 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 NDE methods. Evaluate methods to detect and characterize the severity of fretting fatigue in engine components. Evaluate NDE/I methods to characterize the LO properties of paints and coatings during and after application.

(U) $2,588 Develop and transition enabling technologies to reduce the Air Force maintenance burden due to LO requirements. Validate capability for NDE point inspection devices and verify repair quality. Demonstrate an integrated LO repair kit. Transition high temperature and/or ultraviolet gap sealants and conductive elastomers. Transition ultrasonically applied and/or removed thermoplastic radar absorbing material (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs.

(U) $4,089 Develop support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components. Perform failure analysis and materials investigations for field, acquisition, and depot organizations. Continue certification and transition of emerging electrostatic discharge (ESD) protection materials technologies and techniques for LO applications. Continue experimental evaluation of testing techniques needed for analyzing structural failures of replacement materials for aging Air Force systems.

(U) $6,299 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. Publish residual stresses baseline criteria of high cycle fatigue foreign object damage in turbine engine blade materials. Transition advanced composite materials compatibility with laser effluents as an alternative to metallic materials for high-energy

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

chemical oxygen-iodine laser devices. Transition improved gap-filler materials for LO platforms and demonstrate on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Demonstrate capabilities to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Publish baseline for improved corrosion management procedures.

(U) $18,064 Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0603112F, Advanced Materials for Weapons Systems.

(U) PE 0603211F, Aerospace Structures

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2002

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4915

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4915 Deployed Air Base Technology	0	1,412	2,345	2,236	2,515	2,582	2,647	Continuing	TBD

Note: In FY 2002, Project 4397, efforts transferred from PE 0602102F, into Project 4915.

(U) A. Mission Description

Supports the Air Expeditionary Forces (AEF) through development of new technologies for deployable airbase systems to reduce airlift, setup times, manpower requirements, and sustainment costs. Develops efficient and cost-effective technologies to provide force protection and survivability, including fire fighting, to AEF deployed warfighters. Develops affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapon systems sustainment, and ensure deployability.

(U) FY 2001 ($ in Thousands)

(U) $0 This effort was performed in PE 0602201F, Aerospace Flight Dynamics, Project 4397, Air Base Technology, ($4.157 million).

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $885 Develop new deployable airbase systems to reduce airlift, setup times, manpower requirements, and sustainment costs in support of AEF technologies. Develop lightweight, flexible solar cell technologies that improve operating efficiency and reduce sustainment costs of airmobile systems. Develop lightweight, rapidly assembled matting systems to enable rapid expansion of aircraft parking at deployment locations. Develop effective advanced fire fighting agents and equipment to protect deployed warfighters.

(U) $110 Develop affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapons systems sustainment, and ensure deployablity. Develop safe, cost-effective disposal of problem AEF wastes for low-observable material waste treatment.

(U) $417 Develop efficient and cost-effective technologies to provide force protection and survivability to AEF deployed warfighters and materials. Develop atmospheric threat prediction models and deployable sensors systems to protect AEF forces from toxic industrial materials.

(U) $1,412 Total

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BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials
	PROJECT: 4915

(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$1,697	Develop new deployable airbase systems to reduce airlift, setup times, manpower requirements and sustainment costs in support of AEF technologies. Develop an integrated deployable fuel cell, solar power, and heat pump system that decreases maintenance and mean time between failure, increases operating efficiency, and reduces sustainment costs for air mobile systems performance.
(U)	$158	Develop affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapon systems sustainment, and ensure deployablity. Continue development of safe, cost-effective disposal of problem Air Expeditionary Force (AEF) wastes for low-observable material waste treatment.
(U)	$490	Develop cost-effective technologies to provide force protection and survivability to AEF deployed warfighters and materials. Continue development of atmospheric threat prediction models and deployable sensors systems to protect AEF forces from toxic industrial materials. Develop effective advanced fire fighting agents and equipment and advanced blast protection materials to protect deployed warfighters.
(U)	$2,345	Total

(U) B. Project Change Summary

Not Applicable.

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

(U) Related Activities:

(U) PE 0603112F, Advanced Materials for Weapon Systems

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2002

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 5015

COST ($ in Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
5015 Rocket Materials Technology	0	0	1,340	1,438	1,694	1,812	1,931	Continuing	TBD

Note: In FY 2003, space unique tasks in Project 5015 will be transferred to PE 0602500F, Project 5025, in conjunction with the Space Commission recommendation to consolidate all space unique activities. In FY 2003, non-space unique tasks (and other aerospace materials related technology) will be transferred into this project from PE 0602203F, Project 4847.

(U) A. Mission Description

Develops advanced pervasive materials and processing technology 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) FY 2001 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2002 ($ in Thousands)
(U) $0 No Activity
(U) $0 Total

(U) FY 2003 ($ in Thousands)
(U) $1,340 Develop and demonstrate pervasive materials and processing technology for aerospace engine components and sub-components to dramatically improve affordability, performance, and reliability of current and future Air Force aerospace systems. Evaluate chemistry/heat treatment combination for new compatible alloys for aerospace propulsion housing components. Identify and develop pervasive zero erosion materials for multiple aerospace engine and missile applications. Identify and evaluate pervasive high temperature catalyst materials that will enable the use of high performance monopropellants for aerospace propulsion systems.
(U) $1,340 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE: February 2002
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT: 5015

(U) B. Project Change Summary

Not applicable.

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

(U) Related Activities:

PE 0602500F, Multi-disciplinary Space Technology
PE 0602102F, Materials
PE 0602302F, Aerospace Propulsion

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not applicable.