PE NUMBER: 0602102F
PE TITLE: Materials

| Exhibit R-2, RDT&E Budget Item Justification | DATE February 2008 |
|---|---|
| BUDGET ACTIVITY **02 Applied Research** | PE NUMBER AND TITLE **0602102F Materials** |

| | Cost ($ in Millions) | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Program Element (PE) Cost | 151.438 | 179.516 | 117.143 | 127.504 | 126.999 | 130.567 | 126.415 | Continuing | TBD |
| 01SP | Space Materials Development | 25.728 | 37.558 | 29.042 | 34.161 | 33.801 | 32.654 | 33.337 | Continuing | TBD |
| 4347 | Materials for Structures, Propulsion, and Subsystems | 70.723 | 73.257 | 44.313 | 52.955 | 54.892 | 56.284 | 55.495 | Continuing | TBD |
| 4348 | Materials for Electronics, Optics, and Survivability | 26.687 | 29.751 | 21.480 | 19.990 | 17.982 | 20.032 | 15.807 | Continuing | TBD |
| 4349 | Materials Technology for Sustainment | 21.550 | 27.642 | 18.662 | 17.692 | 17.590 | 18.698 | 18.771 | Continuing | TBD |
| 4915 | Deployed Air Base Technology | 6.750 | 11.308 | 3.646 | 2.706 | 2.734 | 2.899 | 3.005 | Continuing | TBD |

Note: FY 2008 funding totals do not include $3.7 million FY 2008 GWOT requirements still pending Congressional consideration.

**(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 five projects that develop: (1) the materials and processing technology base for spacecraft and launch systems; (2) structural, propulsion, and sub-systems materials and processes technologies; (3) electronic, optical, and survivability materials and processes technologies; (4) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (5) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2008 Congress added $1.6 million for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft, $1.6 million for Free Electron Laser Capabilities for Aerospace Microfabrication, $4.8 million for Intelligent Carbon nanotube Based Computer Devices for Space Applications, $1.0 million for Aircraft Active Corrosion Protective Compounds, $2.8 million for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material, $1.6 million for Blast Resistant Concrete Products, $1.6 million for Large Area, APVT Materials Development for High Power Devices, $1.6 million for Plasma-Sphere Array for Flexible Electronics, $3.0 million for Advanced Carbon Fiber Research and Testing Initiative, $2.5 million for Institute for Science and Engineering Simulation (ISES) / Aircraft Fatigue Modeling and Simulation, $1.6 million for Science for Sustainment Initiative to Improve Mission, $3.2 million for Oregon Nanoscience and Microtechnologies Institute (ONAMI) Safer Nanomaterials and Nanomanufacturing, $1.6 million for Pennsylvania Nanomaterials Commercialization Center, $1.6 million for High Temperature Aerogel Materials for Global Strike Vehicles, $0.8 million for Polymer Nanocomposites for Energy Storage and Pulsed Power, $1.6 million for Carbon Nano-Materials for Advanced Aerospace Applications, AQW Rice University, $2.4 million for University of Houston Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT), $1.6 million for Gallium Nitride (GaN) RF Power Technology, $1.0 million for Life Shield Blast Resistant Panels, $1.6 million for Advanced Aerospace Carbon Foam Heat Exchangers, $0.96 million for Advanced Engineered Non-Linear Optical Materials for Critical Wavelengths, $6.0 million for Air Force Minority Leaders Program, $1.2 million for Durable Hybrid Coatings for Aircraft Systems, $1.6 million for Fire and Blast Resistant Materials for Force Protection, $1.6 million for Nanocomposites for Lightning Protection of Composite Airframe Structures, $5.0 million for Nanotechnology Research, $2.9 million for Polymer Stress and Sensor Damage Sensors for Composites, and $1.0 million for Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction. Congress also reduced Affordable structural and non-structural materials for space by $1.5 million for program growth. This program is in Budget

| Exhibit R-2, RDT&E Budget Item Justification | DATE February 2008 |
|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials |

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

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

| | | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| (U) | Previous President's Budget | 153.293 | 122.794 | 110.412 |
| (U) | Current PBR/President's Budget | 151.438 | 179.516 | 117.143 |
| (U) | Total Adjustments | -1.855 | 56.722 | |
| (U) | Congressional Program Reductions | | -1.500 | |
| | Congressional Rescissions | | -1.138 | |
| | Congressional Increases | | 58.360 | |
| | Reprogrammings | 0.859 | 1.000 | |
| | SBIR/STTR Transfer | -2.714 | | |

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

# Exhibit R-2a, RDT&E Project Justification

DATE: February 2008

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT NUMBER AND TITLE: 01SP Space Materials Development

| Cost ($ in Millions) | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
|---|---|---|---|---|---|---|---|---|---|
| 01SP Space Materials Development | 25.728 | 37.558 | 29.042 | 34.161 | 33.801 | 32.654 | 33.337 | Continuing | TBD |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

Note: In FY 2007, Project 01SP, Space Materials Development, efforts transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5025, Space Materials Development, in order to more effectively manage and provide oversight of the efforts.

**(U) A. Mission Description and Budget Item Justification**

This project develops the materials and processing technology base for spacecraft and launch systems to improve affordability, maintainability, and performance of current and future Air Force space systems. Families of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide new capabilities for spacecraft, ballistic missile, and propulsion systems to meet the future space requirements. Rocket propulsion materials development in this project supports the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. Advanced high-temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet space and ballistic missile requirements. Materials technologies are also being developed to enable surveillance and terrestrial situational awareness systems and subsystems for space and ballistic missile applications.

| **(U) B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (U) MAJOR THRUST: Develop materials and processes to dramatically improve performance, durability, and cost of rocket propulsion systems. Note: In FY 2008, efforts were reduced to fund efforts for high-temperature protection systems. | 11.160 | 3.581 | 3.241 |

(U) In FY 2007: Developed new candidate materials and improved processing techniques to ensure more consistent material characteristics to meet the next level of performance goals for high-speed turbopump housings and turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats. Evaluated performance of subscale test components in representative rocket engine environment. Analyzed material behavior in rocket combustion environment. Demonstrated innovative high-temperature metal, ceramic, and composite material candidates for solid rocket nozzles, exit cones, throats, and spacecraft propulsion components. Validated material models for direct replacement of materials. Scaled-up testing from coupon level to more complex shapes and sizes. Fabricated subscale components. Incorporated innovative materials and concepts on demonstrator engines. Identified materials characteristics required to meet advanced performance and cost goals. Improved and optimized selected materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts.

(U) In FY 2008: Optimize candidate materials and processing techniques to ensure more consistent material characteristics to meet the next level of performance goals for high-speed turbopump housings and turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats. Develop processes to produce full scale test components that can be tested in rocket engine environment. Analyze material behavior in rocket combustion environment. Construct pervasive materials requirements to meet advanced performance and cost goals. Validate and demonstrate

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>01SP Space Materials Development |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts. | | | |
| (U) | In FY 2009: Down select the highest payoff materials and processes for high-speed turbopump housings and turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats and develop mechanical property databases for design consideration. Optimize processes to produce full scale test components that can be tested in rocket engine environment. Analyze material behavior in rocket combustion environment. Focus development plans on pervasive materials requirements to meet advanced performance and cost goals. Optimize selected materials, test sub-elements, and sub-components for thrust chambers, nozzles, and catalysts. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop affordable, advanced structural and non-structural materials and processing technologies for Air Force space applications. Note: In FY 2008, efforts were increased for high-temperature protection systems. In FY 2008 Congress reduced this effort by $1.5 million for program growth. | 10.586 | 18.701 | 14.739 |
| (U) | In FY 2007: Validated initial material design concept of candidate metallic systems for thin gage structures for component operation in robust high-temperature, long duration cruise, or access to space environments. Analyzed research results and developed knowledge base on liquid oxygen compatibility with National Aeronautics and Space Administration (NASA) and industry. Evaluated large integrated concepts using composite materials in cryogenic environments and provided expertise for design and assessment of structural cryogenic tanks. Demonstrated high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Validated oxidation protection schemes for carbon-carbon materials for high-speed vehicle applications. Developed multifunctional nano-tailored composite technologies for space system capabilities and evaluated enhancements obtained. Developed wear-resistant materials, lubricants, and Micro-Electro-Mechanical System (MEMS) devices for moving mechanical assemblies on spacecraft. Evaluated candidate space materials and collected critical data to facilitate materials transition. | | | |
| (U) | In FY 2008: Develop and validate test methodology and evaluation techniques for processing, durability, and life prediction of thermal protection system applications for selected thin gage metallic materials. Develop scale-up processing and integration techniques that will provide the capability for fabrication of complex geometries and built-up structures. Explore materials options for high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Transition data on oxidation protection schemes for carbon-carbon materials. Demonstrate benefits of nano-tailored composite materials for multifunctional space applications. Validate wear-resistant materials, lubricants, and MEMS devices for moving mechanical assemblies on spacecraft against environment specific criteria. Evaluate candidate space materials and collect critical data to facilitate materials transition. | | | |
| (U) | In FY 2009: Optimize initial test methodology and evaluation techniques for processing, durability, and life | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>01SP Space Materials Development |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | prediction of thermal protection system applications for component operation in robust high-temperature, long-duration cruise, or access to space environments. Continue materials processing development and demonstrate structural integration into sub-scale components for testing in relative environments. Develop materials candidates for high-temperature protection systems for expendable and reusable high-speed vehicle applications in collaboration with industry. Evaluate candidate space materials and collect critical data to facilitate materials transition. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop materials and materials processing technologies to enable improved performance and affordability of surveillance, tracking, targeting, situational awareness systems, and space-based communications/computing. Note: Beginning in FY 2008, there in an increased emphasis on efforts in this major thrust. | 3.982 | 10.507 | 11.062 |
| (U) | In FY 2007: Initiated development of nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Validated processes and developed process control methodology to enable very long wavelength infrared detection. Developed suitable materials and materials process technologies for application in combined optical and radio frequency communication system apertures. Initiated research in nano-photonic materials for applications in very high bandwidth communications and modulators, laser communications, and radar. | | | |
| (U) | In FY 2008: Demonstrate processes and process control methodology to enable very long wavelength infrared detection. Develop materials processing technology for short wavelength detectors that will provide capability of staring focal plane arrays with more than 4 million pixels (2k x 2k). Develop nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Demonstrate materials and materials process technologies for application in combined optical and radio frequency communication system apertures. | | | |
| (U) | In FY 2009: Continue to demonstrate processes and process control methodology to enable very long wavelength infrared focal plane arrays. Demonstrate processing technology for short wavelength infrared detectors by hybridization and characterization of 2k x 2k format focal plane array. Demonstrate nano-photonic materials for high performance optoelectronic devices for optical communications and system control architectures. Transition suitable materials and materials process technologies for application in combined optical and radio frequency communication system apertures. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Intelligent Carbon Nanotube Based Computer Devices for Space Applications. | 0.000 | 4.769 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Intelligent Carbon Nanotube Based Computer Devices for | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>01SP Space Materials Development |

**(U) B. Accomplishments/Planned Program ($ in Millions)**

| | | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | Space Applications. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | Total Cost | 25.728 | 37.558 | 29.042 |

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

| | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|
| (U) Related Activities: | | | | | | | | | |
| (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. | | | | | | | | | |

**(U) D. Acquisition Strategy**

Not applicable.

| Exhibit R-2a, RDT&E Project Justification | | | DATE: February 2008 |
|---|---|---|---|
| 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 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 4347 | Materials for Structures, Propulsion, and Subsystems | 70.723 | 73.257 | 44.313 | 52.955 | 54.892 | 56.284 | 55.495 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

**(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. Develops novel materials for electromagnetic interactions with matter for electromagnetic pulse (EMP), high power microwave (HPM), and lightning strike protection. Concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

| **(U) B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (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. | 3.714 | 3.171 | 2.389 |

(U) In FY 2007: Demonstrated advanced ceramic composite performance through testing under real and simulated engine service life conditions. Incorporated environmental degradation analysis into the ceramic composite life prediction model to address time dependent degradation associated with environmental exposure. Demonstrated the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing.

(U) In FY 2008: Demonstrate advanced ceramic composite performance through testing under real and simulated engine service life conditions. Demonstrate environmental degradation analysis in the ceramic composite life prediction model. Validate the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing.

(U) In FY 2009: Validate advanced ceramic composite performance through testing under real and simulated engine service life conditions. Validate the life prediction model to address time dependent degradation associated with environmental exposure. Validate the severe environment durability of advanced ceramic composite systems with advanced interfaces via mechanical testing.

(U)

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| BUDGET ACTIVITY<br>**02 Applied Research** | PE NUMBER AND TITLE<br>**0602102F Materials** | PROJECT NUMBER AND TITLE<br>**4347 Materials for Structures, Propulsion, and Subsystems** |

| (U) **B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop enabling polymeric materials for diverse aerospace applications including enhanced aircraft canopies, electromagnetic hardening, and improved low-observable platforms. Develop nanoscale architectures to address electromagnetic applications. Note: In FY 2009, this increase in funding is due to greater emphasis on metamaterials. This effort includes Congressional Add funding of $5.7 million in FY 2007 ($2.3 million for ONAMI Safer Nanomaterials and Nanomanufacturing, $1.4 million for Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT), $1.0 million for Advanced Materials Development for Force Protection, and $1.0 million for Enabling Polymeric Materials for Three-Dimensional (3D) Microdevice Construction). | 11.017 | 6.324 | 13.320 |

(U) In FY 2007: Developed second-generation TPA materials for night vision goggle and optical limiting applications. Demonstrated optical limiting with improvements in nonlinear optical properties using photonic crystals. Demonstrated improved life nanostructured aircraft tires. Demonstrated aromatic hyperbranched polymers as rheology-modifying additives for structural component manufacture via resin transfer molding processes. Demonstrated organic-inorganic nanostructured materials for Air Force electromagnetic applications. Developed adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Demonstrated polymer proton exchange membranes for Air Force fuel cell applications. Demonstrated polymer photovoltaic materials for high efficiency, long life, lightweight, solar cell applications.

(U) In FY 2008: Deliver second-generation TPA materials for night vision goggle evaluation. Transition photonic crystals for super prism applications. Transition aromatic hyperbranched polymers for structural component manufacture via resin transfer molding processes. Develop organic-inorganic metamaterials for Air Force electromagnetic and photonic applications for reduced aperture size, conformal radar, and antenna systems. Transition organic-inorganic nanostructured materials for lightning strike resistant refueling boom. Develop electromagnetic interference (EMI) and high power microwave (HPM) shielding for electronics hardening. Develop adaptive (shape memory and actuator) materials based on polymer nanocomposites for adaptive aircraft structures, wings, fins, antennas, and mirrors. Develop lightweight, low-cost photovoltaics for uninhabited air vehicle applications.

(U) In FY 2009: Develop organic-inorganic metamaterials for Air Force electromagnetic and photonic applications for reduced aperture size, conformal radar, and antenna systems. Develop EMI and HPM shielding for electronics hardening. Investigate and develop lightweight, conformal metamaterials with properties that will enable compact sensor applications including: conformal array antennas, low EMI electronics, and optical elements based upon complex media. Evaluate the properties of these materials and determine performance enhancement of fixed

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4347 Materials for Structures, Propulsion, and Subsystems |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | frequency metamaterial optical elements. Assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based on radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. | | | |
| (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: This effort includes Congressional Add funding of $4.3 million in FY 2007 ($1.0 million for Domestic Titanium Powder Manufacturing Initiative and $3.3 million for Advanced Aerospace Manufacturing Technologies). | 20.805 | 15.639 | 11.035 |
| (U) | In FY 2007: Developed materials-damage predictive approaches for engine health determination and life extension capability. Explored advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Developed computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems. Demonstrated processes and protocols for unitized manufacturing of aerospace components. | | | |
| (U) | In FY 2008: Develop materials-damage predictive approaches for engine health determination and life extension capability. Develop advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Validate computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force systems. | | | |
| (U) | In FY 2009: Validate materials-damage predictive approaches for engine health determination and life extension capability. Develop and validate advanced metallic materials for enhanced performance propulsion for air platforms with an emphasis on higher temperature capability. Transition computational methods supporting development and processing to reduce costs to accelerate insertion of advanced metals into Air Force 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: This effort includes Congressional Add funding of $4.0 million in FY 2007 ($2.0 million for Domestic High Modulus PAN Carbon Fiber Qualification Initiative, $1.0 million for High Temperature Aerogel Materials for Global Strike Vehicles, and $1.0 million for Hybrid Materials Integration). | 13.386 | 8.715 | 7.943 |
| (U) | In FY 2007: Demonstrated tools and methodologies required for life prediction of materials in high temperature | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>**02 Applied Research** | PE NUMBER AND TITLE<br>**0602102F Materials** | PROJECT NUMBER AND TITLE<br>**4347 Materials for Structures, Propulsion, and Subsystems** |

| | **B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | turbine engine and airframe structures environments. Demonstrated high temperature organic matrix composites onto relevant DoD platforms. Initiated new material development and affordable processing for space and high-speed vehicle applications. Developed new materials and processes for nanotailored composites with multifunctional capabilities. Continued nanomaterial modeling and technology efforts. Developed and demonstrated advanced material concepts and processes for thermal management applications. | | | |
| (U) | In FY 2008: Continue demonstration of life prediction tools for engine and airframe applications. Transition high temperature organic matrix composites. Downselect and optimize most promising new material systems for space and high speed vehicle applications. Demonstrate the multifunctional payoffs of nanotailored composite materials for aerospace platform applications. Develop and demonstrate nanomaterials modeling and technology with an emphasis on accelerating the insertion and transition of this class of materials. Validate advanced composite material concepts and processes for specific weapon system needs. | | | |
| (U) | In FY 2009: Validate benefits of life prediction tools for engine and airframe applications. Demonstrate improved performance of new material systems for space and high-speed vehicle applications. Integrate the developed models into commercial and industry tools. Develop advanced material concepts and processes to address thermal management applications for weapon and air vehicle platforms. | | | |
| (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: This effort includes Congressional Add funding of $7.2 million in FY 2007 ($1.3 million for Durable Hybrid Coatings for Aircraft Systems, $1.0 million for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft, $1.0 million for Secure Coating Systems Technology, $1.0 million for Integral Fuel Tank Protective Coating System, and $2.9 million for Advanced Coating Technologies for JSF and F-22 Survivability). | 15.440 | 6.717 | 4.355 |
| (U) | In FY 2007: Demonstrated candidate gap treatment materials on air vehicles. Completed validation of the advanced analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Demonstrated and validated the non-chromate surface treatments for aircraft corrosion protection systems. Formulated chrome-free primer for corrosion protection systems with a 30-year life expectancy. Validated multifunctional coatings on engineering components. Downselected surface treatment candidates for further development for friction, stiction, and wear control in micro devices. | | | |
| (U) | In FY 2008: Transition candidate gap treatment materials on low observable air vehicles. Demonstrate the analytical models that will be used to predict the optical properties of specialty coatings based on measured data. Transition the non-chromate surface treatments for aircraft corrosion protection systems. Validate chrome-free | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4347 Materials for Structures, Propulsion, and Subsystems |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | primer for corrosion protection systems with a 30-year life expectancy. Demonstrate improved low friction wear multifunctional coatings on engineering components. Develop and optimize surface treatment candidates for friction, stiction, and wear control in micro devices. | | | |
| (U) | In FY 2009: Integrate the analytical models into the coatings development applications. Demonstrate chrome-free primer for corrosion protection systems with a 30-year life expectancy. Continue to demonstrate improved low friction wear multifunctional coatings on engineering components. Demonstrate surface treatment candidates for friction, stiction, and wear control in micro devices. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop nanomaterials science and technology in the areas of nanoenergetics to provide nano-reactive materials, additives, coated powders and laminates for munitions and propulsion with reduced size and higher lethality. Note: In FY 2008, this major thrust pulls together existing technologies from across the Air Force Research Laboratory to create an integrated nanoenergetics effort. | 0.000 | 6.062 | 5.271 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Investigate large-scale synthesis and characterization of energetic nanomaterials to provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions and access to space. Discover and design unconventional nanomaterial behavior with regard to energy release via robust modeling and simulation. Investigate the transport and compartmentalization of nanoparticles within the environment. Develop microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems. Investigate multi-component, structured nanoparticle catalyses as controlled release agents for enhancing stability and storage as well as providing enhanced ignition for high efficiency air-breathing propulsion. | | | |
| (U) | In FY 2009: Develop large-scale synthesis and characterization of energetic nanomaterials to provide stable, triggerable, nanoscale energetic materials for enhanced energy release munitions, high efficiency air-breathing propulsion, and access to space. Establish modeling and simulation tools to support nanoenergetics development. Analyze the transport and compartmentalization of nanoparticles being investigated as nanoenergetics to evaluate potential environmental impact. Develop microstructural characterization tools to provide robust processing-performance correlations of nanoenergetic systems. Investigate multi-component, structured nanoparticle catalyses as controlled release agents for enhancing stability and storage as well as providing enhanced ignition. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Air Force Minority Leaders Program. | 5.383 | 5.962 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Air Force Minority Leader Program. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Air Force Minority Leaders Program. | | | |

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| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4347 Materials for Structures, Propulsion, and Subsystems |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Pennsylvania Nanomaterials Commercialization Center. | 0.978 | 1.589 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for NanoMaterials Commercialization Center. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Pennsylvania Nanomaterials Commercialization Center. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Carbon Nano-Materials for Advanced Aerospace Applications, AQW Rice University. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Carbon Nano-Materials for Advanced Aerospace Applications, AQW Rice University. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Nanocomposites for Lightning Protection of Composite Airframe Structures. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Nanocomposites for Lightning Protection of Composite Airframe Structures. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Nanotechnology Research. | 0.000 | 4.970 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Nanotechnology Research. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: ONAMI Safer Nanomaterials and Nanomanufacturing. | 0.000 | 3.182 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for ONAMI Safer Nanomaterials and Nanomanufacturing. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: University of Houston Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT). | 0.000 | 2.385 | 0.000 |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>**02 Applied Research** | PE NUMBER AND TITLE<br>**0602102F Materials** | PROJECT NUMBER AND TITLE<br>**4347 Materials for Structures, Propulsion, and Subsystems** |

| | **B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for University of Houston CONTACT. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction. | 0.000 | 0.993 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Innovative Polymeric Materials for 3-D Microdevice Construction. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: High Temperature Aerogel Materials for Global Strike Vehicles. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for High Temperature Aerogel Materials for Global Strike Vehicles. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Durable Hybrid Coatings for Aircraft Systems. | 0.000 | 1.192 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Durable Hybrid Coatings for Aircraft Systems. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Chrome Free Environmentally Friendly Corrosion Protection for Aircraft. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | Total Cost | 70.723 | 73.257 | 44.313 |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4347 Materials for Structures, Propulsion, and Subsystems |

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

| | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|

(U) Related Activities:

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

(U) PE 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0603216F, Aerospace Propulsion and Power Technology.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

**(U) D. Acquisition Strategy**

Not Applicable.

| Exhibit R-2a, RDT&E Project Justification | | | DATE: February 2008 |
|---|---|---|---|
| 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 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 4348 | Materials for Electronics, Optics, and Survivability | 26.687 | 29.751 | 21.480 | 19.990 | 17.982 | 20.032 | 15.807 | Continuing | TBD |
| | Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

**(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 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (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. | 1.184 | 1.720 | 1.917 |

(U) In FY 2007: Validated optical, structural, and electronic properties of innovative IR materials to determine their ability to provide unique IR detection properties of interest to the Air Force. Characterized and evaluated the utility of single element multispectral IR materials with responses to more than two discrete wavelengths. Investigated the potential for three-dimensional material growth to exploit unique detection properties of complex IR materials. Validated promising materials growth technologies for nano-scale IR detection materials.

(U) In FY 2008: Explore and validate suitable materials and structures for innovative IR materials in order to assess appropriateness for Air Force IR detection applications. Design and demonstrate IR materials systems capable of responses to more than two discrete wavelengths. Assess feasibility of further research and utility of three-dimensional material growth to exploit unique detection properties of complex IR materials. Develop promising materials growth technologies for nano-scale IR detection materials. Develop epitaxial materials and devices fabricated for high power applications. Investigate materials to enable development of design capabilities. Improve materials matching between device and substrates to enable higher power efficiency, better reliability, and increased power density to enable power dense devices.

(U) In FY 2009: Develop materials and transition strategies for innovative IR materials while continuing to exploit newly emerging material concepts. Validate and optimize IR materials systems capable of responses to more than two discrete wavelengths. Develop candidate materials for three-dimensional growth to exploit unique detection

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4348 Materials for Electronics, Optics, and Survivability |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | properties of complex IR materials. Develop promising materials growth technologies for nano-scale IR detection materials. Demonstrate epitaxial materials device and substrate improvements. Develop design capability, leveraging new materials and substrates. Develop tools and methodologies that address the physics of failure for power dense devices. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop and demonstrate enabling materials technologies to enhance the safety, survivability, and mission effectiveness of aircrews, sensors, viewing systems, and related assets. | 7.613 | 9.721 | 9.522 |
| (U) | In FY 2007: Incorporated optimized nonlinear optical limiter materials for damage protection of eyes and sensor systems. Optimized photorefractive materials properties for Air Force passive protection applications. Incorporated switchable filter technology into device concepts for eye and sensor system protection. | | | |
| (U) | In FY 2008: Demonstrate optimized nonlinear optical limiter materials for damage protection of eyes and sensor systems. Validate photorefractive materials properties for Air Force passive protection applications. Develop devices using switchable filter technology into eye and sensor system protection concepts. | | | |
| (U) | In FY 2009: Develop nonlinear optical limiter materials into device concepts for damage protection of eyes and sensor systems. Develop photorefractive materials into device concepts for Air Force passive protection applications. Demonstrate devices using switchable filter technology into eye and sensor system protection concepts. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate 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: This effort includes Congressional Add funding of $2.4 million in FY 2007 ($1.4 million for Power Electronics Reliability and $1.0 million for Advanced Materials Deposition for Semiconductor). | 9.767 | 8.231 | 8.340 |
| (U) | In FY 2007: Demonstrated capabilities of advanced materials and materials process technologies to enable airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Demonstrated scale-up of materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic countermeasures. Demonstrated capabilities of advanced materials and materials process technologies to provide improvements and additional capabilities relative to baseline materials/processes for ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Validated and demonstrated selected materials and materials process technologies for use in Terahertz components, supporting high speed communications and advanced sensors. | | | |
| (U) | In FY 2008: Explore materials impact on device reliability for power control systems, advanced radar, and electronic | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4348 Materials for Electronics, Optics, and Survivability |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | countermeasures application. Demonstrate the capabilities of advanced materials process technologies as well as investigate the reliability of materials as applied to ultra-lightweight, ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Demonstrate performance of candidate materials for use in Terahertz components, supporting high speed communications and advanced sensors. | | | |
| (U) | In FY 2009: Optimize materials properties for enhanced device reliability. Assess the reliability of materials for ultra-lightweight, ultra-high-power aircraft electrical generator applications, enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft. Demonstrate performance of candidate materials for use in Terahertz components, supporting high speed communications and advanced sensors. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop enabling and foundational biotechnologies for the areas of guidance and control, rapid tagging, tracking, and identification of targets, and bio-integrated electronics and sensing for continued Air Force dominance. Note: In FY 2008, this major thrust pulls together existing technologies from across the Air Force Research Laboratory to create an integrated biotechnologies effort for taggants. | 0.000 | 1.972 | 1.701 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Investigate use of biological/nanomaterial-based taggants for the detection and identification of CBRNE targets at a distance using hybrid constructs. Assess effectiveness of CBRNE destruction using taggants in counterproliferation operations. Neutralize biological and chemical agents with the inherent and supplementary properties of the taggant nanoparticles. Develop active and passive polymer encapsulation technologies for taggant materials. | | | |
| (U) | In FY 2009: Develop new biological/nanomaterial hybrids for the detection and identification of CBRNE agents. Analyze efficacy data of using taggants to destroy CBRNE agents. Incorporate taggants into a variety of media (polymers, paints) for optimal and mission-specific dispersal. Model dispersion properties of polymer-encapsulated taggants for optimal release and coverage. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Engineered Optical Materials for Quantum Cryptography. | 0.978 | 0.000 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Engineered Optical Materials for Quantum Cryptography. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4348 Materials for Electronics, Optics, and Survivability |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| (U) | CONGRESSIONAL ADD: Electronic Type-specific Buckytubes for Next Generation Defense Electronics. | 1.959 | 0.000 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Electronic Type-specific Buckytubes for Next Generation Defense Electronics. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Fabrication and Processing of Adaptive Optics and Optical Materials. | 1.370 | 0.000 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Fabrication and Processing of Adaptive Optics and Optical Materials. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Quantum Wire Program for Defense. | 0.978 | 0.000 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Quantum Wire Program for Defense. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Wide Bandgap Materials Integration for Power Electronic, Sensor, and Optical Devices. | 2.838 | 0.000 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Wide Bandgap Materials Integration for Power Electronic, Sensor, and Optical Devices. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Advanced Engineered Non-Linear Optical Materials for Critical Wavelengths. | 0.000 | 0.955 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Advanced Engineered Non-Linear Optical Materials for Critical Wavelengths. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Free Electron Laser Capabilities for Aerospace Microfabrication. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>**02 Applied Research** | PE NUMBER AND TITLE<br>**0602102F Materials** | PROJECT NUMBER AND TITLE<br>**4348 Materials for Electronics, Optics, and Survivability** |

| | **B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| (U) | In FY 2008: Conduct Congressionally-directed effort for Free Electron Laser Capabilities for Aerospace Microfabrication. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Gallium Nitride (GaN) RF Power Technology. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Gallium Nitride (GaN) RF Power Technology. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Large Area, APVT Materials Development for High Power Devices. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Large Area, APVT Materials Development for High Power Devices. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Plasma-Sphere Array for Flexible Electronics. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Plasma-Sphere Array for Flexible Electronics. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Polymer Nanocomposites for Energy Storage and Pulsed Power. | 0.000 | 0.796 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Polymer Nanocomposites for Energy Storage and Pulsed Power. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | Total Cost | 26.687 | 29.751 | 21.480 |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4348 Materials for Electronics, Optics, and Survivability |

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

| | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 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 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0603231F, Crew Systems and Personnel Protection Technology.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

**(U) D. Acquisition Strategy**

Not Applicable.

# Exhibit R-2a, RDT&E Project Justification

DATE: **February 2008**

BUDGET ACTIVITY: **02 Applied Research**

PE NUMBER AND TITLE: **0602102F Materials**

PROJECT NUMBER AND TITLE: **4349 Materials Technology for Sustainment**

| Cost ($ in Millions) | | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 4349 | Materials Technology for Sustainment | 21.550 | 27.642 | 18.662 | 17.692 | 17.590 | 18.698 | 18.771 | Continuing | TBD |
| | 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 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (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. | 6.046 | 6.303 | 6.890 |
| (U) In FY 2007: Developed computer simulations and models of NDI/E technique response to enable rapid assessment of multiple NDI/E technologies for depot level inspections. Developed NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Developed advanced LO NDI/E methods and systems for use in battle damage assessment and for inspection following battle damage repair. | | | |
| (U) In FY 2008: Mature modeling and simulation methodologies for rapid assessment of multiple NDI/E technologies for depot level inspections. Validate NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Initiate studies of harsh environment sensors to enable health management for turbine engines and thermal protection systems. | | | |
| (U) In FY 2009: Demonstrate novel NDI/E methods and techniques to detect and track damage in a wide variety of materials and components for aerospace systems. Demonstrate NDI/E technologies for inspection of thick (multi-layer) aging aircraft structures with complex geometries. Develop sensing technology to detect changes in temperature, strain, pressure, and vibration to enable on-demand health status of turbine engines, aircraft structures, wiring systems, and thermal protection systems. | | | |
| (U) | | | |
| (U) MAJOR THRUST: Develop support capabilities, information, and processes to resolve problems with materials in the repair of aircraft structures and to reduce aircraft corrosion. | 7.401 | 4.859 | 5.163 |
| (U) In FY 2007: Evaluated corrosion and erosion resistance of new and emerging materials used in operationally fielded | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4349 Materials Technology for Sustainment |

| (U) B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| Air Force systems. Evaluated methodologies to test failure limits for MEMS structures and subsystems. Validated effects of defects in laser additive manufactured parts. | | | |
| (U) In FY 2008: Develop advanced techniques to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Develop advanced materials and processes technology to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Initiate analysis to understand the effects of materials processes, such as the application of residual stress on the surface of steel and other structural metals, to support customer focused studies and point design solutions that will extend the life of specific components on Air Force systems. Demonstrate technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems. | | | |
| (U) In FY 2009: Validate advanced techniques to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Evaluate advanced materials and processes technology to repair Air Force legacy systems and test failure limits for emerging Air Force systems. Develop test methods and techniques to understand the effects of materials processes, such as the application of residual stress on the surface of steel and other structural metals, to support studies and point design solutions that will extend the life of specific structural components on Air Force systems. Demonstrate and transition technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, and multifunctional systems. | | | |
| (U) | | | |
| (U) MAJOR THRUST: Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components. | 4.906 | 5.749 | 6.609 |
| (U) In FY 2007: Performed failure analysis and materials investigations for field, acquisition, and depot organizations. Demonstrated electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Validated new test methodologies for analyzing structural failures of emerging materials for Air Force systems. Evaluated and validated wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapons systems. | | | |
| (U) In FY 2008: Perform quick response failure analysis and materials investigations for fielded system, acquisition organization, depot system materials failures, and provide advanced materials solutions to ensure system availability and safety of flight. Develop advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrate advanced test methodologies for analyzing structural failures of emerging materials for Air Force systems. Develop advanced wiring materials technologies to replace aging wiring systems | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4349 Materials Technology for Sustainment |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | and new wiring technologies for emerging weapons systems. | | | |
| (U) | In FY 2009: Perform quick response failure analysis and materials investigations for fielded system, acquisition organization, depot system materials failures, and provide advanced materials solutions to ensure system availability and safety of flight. Develop advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Demonstrate advanced test methodologies for analyzing structural failures of emerging materials for Air Force systems. Develop advanced wiring materials technologies to replace aging wiring systems and new wiring technologies for emerging weapons systems. | | | |
| (U) | | | | |
| (U) | MAJOR THRUST: Develop enabling technologies to reduce the Air Force LO maintenance burden. Note: In FY 2008, efforts in this thrust will be combined with other major thrusts in this project. | 0.825 | 0.000 | 0.000 |
| (U) | In FY 2007: Developed technologies for improved maintainability of advanced LO materials and designs, such as conductive outer-mold-line, applique, door edges and seals, multifunctional systems, and embedded LO NDI/E. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Accelerated Insertion of Advanced Materials for Materials Substitution and Repair-National Institute for Aviation Research. | 1.272 | 0.000 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Accelerated Insertion of Advanced Materials for Materials Substitution and Repair-National Institute for Aviation Research. | | | |
| (U) | In FY 2008: Not Applicable. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material. | 1.100 | 2.783 | 0.000 |
| (U) | In FY 2007: Conducted Congressionally-directed effort for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Aircraft Active Corrosion Protective Compounds. | 0.000 | 0.993 | 0.000 |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>**02 Applied Research** | PE NUMBER AND TITLE<br>**0602102F Materials** | PROJECT NUMBER AND TITLE<br>**4349 Materials Technology for Sustainment** |

| | **B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Aircraft Active Corrosion Protective Compounds. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Institute for Science and Engineering Simulation (ISES) / Aircraft Fatigue Modeling and Simulation. | 0.000 | 2.484 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Institute for Science and Engineering Simulation (ISES) / Aircraft Fatigue Modeling and Simulation. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Polymer Stress and Sensor Damage Sensors for Composites. | 0.000 | 2.882 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Polymer Stress and Sensor Damage Sensors for Composites. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Science for Sustainment Initiative to Improve Mission. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Science for Sustainment Initiative to Improve Mission. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | Total Cost | 21.550 | 27.642 | 18.662 |

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

| | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|
| (U) Related Activities: | | | | | | | | | |
| (U) PE 0603112F, Advanced Materials for Weapons Systems. | | | | | | | | | |
| (U) PE 0603211F, Aerospace Technology Dev/Demo. | | | | | | | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>**02 Applied Research** | PE NUMBER AND TITLE<br>**0602102F Materials** | PROJECT NUMBER AND TITLE<br>**4349 Materials Technology for Sustainment** |

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

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

**(U) D. Acquisition Strategy**

Not Applicable.

# Exhibit R-2a, RDT&E Project Justification

DATE: February 2008

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT NUMBER AND TITLE: 4915 Deployed Air Base Technology

| Cost ($ in Millions) | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total |
|---|---|---|---|---|---|---|---|---|---|
| 4915 Deployed Air Base Technology | 6.750 | 11.308 | 3.646 | 2.706 | 2.734 | 2.899 | 3.005 | Continuing | TBD |
| Quantity of RDT&E Articles | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

**(U) A. Mission Description and Budget Item Justification**

This project develops new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs, and to improve protection and survivability of deployed Air Expeditionary Force (AEF) warfighters. Affordable, efficient technologies are developed for base infrastructure, fire fighting, and force protection to improve Expeditionary Combat Support operations.

| **(U) B. Accomplishments/Planned Program ($ in Millions)** | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (U) MAJOR THRUST: Develop new deployable airbase technologies to reduce airlift and manpower requirements, setup times, and sustainment costs in support of AEF operations. | 1.939 | 1.226 | 1.650 |
| (U) In FY 2007: Developed high-efficiency solar shelter fabrics. Developed advanced heat and mass transfer technologies and demonstrated logistic fuel processing planar technology. Investigated behavior of soil and stabilizer interaction with airfield matting and begin model development. Developed non-radar wave methods of nondestructive inspection of airfield surface anomalies. Synthesized polymer materials using biocatalysts and reagents for producing reduced cost, tailored characteristics in aerospace materials. | | | |
| (U) In FY 2008: Develop and analyze solar power for bare base applications. Transition fuel cell reformer specification for acquisition. Begin development of advanced integrated power technologies. Investigate and evaluate high temperature effects on operating surfaces and develop repair technology. Demonstrate nondestructive inspection of airfield surface evaluation technologies. Demonstrate cost effectiveness and performance of synthesized polymer materials. | | | |
| (U) In FY 2009: Analyze and demonstrate renewable power technologies applicable to deployed forces. Demonstrate advanced integrated power technologies. Evaluate and develop mitigation for high temperature effects on operating surfaces. Demonstrate and analyze nondestructive inspection of airfield surface evaluation technologies. | | | |
| (U) | | | |
| (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable technologies to provide force protection and survivability to AEF deployed warfighters and infrastructure. Note: This effort includes Congressional Add funding of $3.1 million in FY 2007 ($2.0 million for Blast Resistant Panels for Buildings, Shelters, and Vehicles and $1.1 million for Fire and Blast Resistant Materials for Force Protection). | 4.811 | 1.338 | 1.996 |
| (U) In FY 2007: Demonstrated emerging fire suppression technologies for integrated crash/rescue capability. Integrated individual fire fighter effectiveness technologies for a combined technology demonstration. Demonstrated resilient structural materials and methodologies for improved protection of structures and inhabitants. Developed technologies to protect against the ballistic and fragmentation effects of improvised explosive device threats, and | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4915 Deployed Air Base Technology |

| | B. Accomplishments/Planned Program ($ in Millions) | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|---|
| | initiated protective material development against high energy threats. Developed characterization data for atmospheric models for protection of deployed warfighters from asymmetric threats. | | | |
| (U) | In FY 2008: Develop methodologies to characterize candidate fire suppression agents and begin development of supporting fire suppression technologies for crash/rescue. Develop and evaluate combined technologies for fire fighter effectiveness. Demonstrate and analyze effectiveness of resilient structural materials and methodologies for improved protection of structures and inhabitants. Investigate and analyze effectiveness of innovative improvised explosive detection and defeat for high energy threat. Investigate mechanisms of gas phase kinetics. Develop and evaluate accuracy for atmospheric models for protection of deployed warfighters from asymmetric threats. | | | |
| (U) | In FY 2009: Develop and demonstrate methodologies to characterize candidate fire suppression agents and continue to develop supporting fire suppression technologies for crash/rescue. Develop and analyze combined technologies for fire fighter effectiveness. Validate and demonstrate resilient structural materials and methodologies for improved protection of structures and inhabitants. Develop and demonstrate effectiveness of innovative defeat of IED and high energy threats. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Blast Resistant Concrete Products. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Blast Resistant Concrete Products. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Life Shield Blast Resistant Panels. | 0.000 | 0.995 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Life Shield Blast Resistant Panels. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Fire and Blast Resistant Materials for Force Protection. | 0.000 | 1.589 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Fire and Blast Resistant Materials for Force Protection. | | | |
| (U) | In FY 2009: Not Applicable. | | | |
| (U) | | | | |
| (U) | CONGRESSIONAL ADD: Advanced Carbon Fiber Research and Testing Initiative. | 0.000 | 2.982 | 0.000 |
| (U) | In FY 2007: Not Applicable. | | | |
| (U) | In FY 2008: Conduct Congressionally-directed effort for Advanced Carbon Fiber Research and Testing Initiative. | | | |

| Exhibit R-2a, RDT&E Project Justification | | DATE February 2008 |
|---|---|---|
| BUDGET ACTIVITY<br>02 Applied Research | PE NUMBER AND TITLE<br>0602102F Materials | PROJECT NUMBER AND TITLE<br>4915 Deployed Air Base Technology |

**(U) B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2007 | FY 2008 | FY 2009 |
|---|---|---|---|
| (U) In FY 2009: Not Applicable. | | | |
| (U) | | | |
| (U) CONGRESSIONAL ADD: Advanced Aerospace Carbon Foam Heat Exchangers. | 0.000 | 1.589 | 0.000 |
| (U) In FY 2007: Not Applicable. | | | |
| (U) In FY 2008: Conduct Congressionally-directed effort for Advanced Aerospace Carbon Foam Heat Exchangers. | | | |
| (U) In FY 2009: Not Applicable. | | | |
| (U) | | | |
| (U) Total Cost | 6.750 | 11.308 | 3.646 |

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

| | FY 2007 Actual | FY 2008 Estimate | FY 2009 Estimate | FY 2010 Estimate | FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|
| (U) Related Activities: | | | | | | | | | |
| (U) PE 0603112F, Advanced Materials for Weapon Systems. | | | | | | | | | |
| (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. | | | | | | | | | |

**(U) D. Acquisition Strategy**

Not Applicable.