RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE February 2005			
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research				R-1 ITEM NOMENCLATURE Materials & Biological Technology PE 0602715E, R-1 # 18				
COST (In Millions)	FY 2004	FY2005	FY2006	FY2007	FY 2008	FY 2009	FY 2010	FY 2011
Total Program Element (PE) Cost	0.000	256.480	294.188	299.844	304.784	315.107	316.107	323.107
Materials Processing Technology MBT-01	0.000	166.330	177.790	172.617	175.750	184.772	185.772	192.772
Biologically Based Materials and Devices MBT-02	0.000	90.150	116.398	127.227	129.034	130.335	130.335	130.335

(U) Mission Description:

(U) This program element is budgeted in the Applied Research Budget Activity because its objective is to develop technologies related to those materials and biological systems that make possible a wide range of new military capabilities. This program element was created in accordance with congressional intent in the FY 2005 DOD appropriations bill. Prior year funding was budgeted in PE 0602712E, Projects MPT-01 and MPT-09.

(U) The major goal of the Materials Processing Technology project is to develop novel materials, materials processing techniques, mathematical models and fabrication strategies for advanced structural and functional materials and components that will lower the cost, increase the performance, and/or enable new missions for military platforms and systems. Included in this project are efforts across a wide range of materials including: structural materials and devices, smart materials and actuators, functional materials and devices, and materials that are enabling for improvements in logistics (i.e., novel power sources, water purification, etc.).

(U) The Biologically Based Materials and Devices Project acknowledges the growing and pervasive influence of the biological sciences on the development of new materials and devices as well as the commensurate influence of materials, physics and chemistry on new approaches to biology and biochemistry. Contained in this project are thrusts in the application of biomimetic materials and devices for Defense, the development of biochemical materials to maintain performance, the use of biology's unique fabrication capabilities to produce structures that cannot be made any other way, the application of magnetic materials in biological applications, and the development of manufacturing tools that use biological components and processes for material synthesis.

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(U) Program Change Summary: *(In Millions)*

	FY 2005	FY 2006	FY 2007
Previous President's Budget	249.336	246.897	240.175
Current Budget	256.480	294.188	299.844
Total Adjustments	7.144	47.291	59.669

Please note that this program element has been newly created from several projects previously funded in PE 0602712E. The *Previous President's Budget* amount reflects projects MPT-01 and MPT-09 funded under that PE.

Congressional program reductions	-7.856
Congressional increases	15.000
Reprogrammings	0.000
SBIR/STTR transfer	0.000

(U) Change Summary Explanation:

FY 2005	Increase reflects congressional adds for six materials programs offset by a congressional program reduction to Biofabrication and undistributed reductions.
FY 2006 - 2007	Increase reflects additional efforts in the Materials for Logistics program and additional efforts in the area of prosthetic technology and increases in other biological programs.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research			R-1 ITEM NOMENCLATURE Materials & Biological Technology PE 0602715E, Project MBT-01					
COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Materials Processing Technology MBT-01	0.000	166.330	177.790	172.617	175.750	184.772	185.772	192.772

(U) Mission Description:

(U) The major goal of this project is to develop novel materials, materials processing techniques, mathematical models and fabrication strategies for advanced structural and functional materials and components that will lower the cost, increase the performance, and/or enable new missions for military platforms and systems. Included in this project are efforts across a wide range of materials including: structural materials and devices, smart materials and actuators, functional materials and devices, and materials that are enabling for improvements in logistics. This program element and project were created in accordance with congressional intent in the FY 2005 DoD appropriations bill. Prior year funding was budgeted in PE 0602712E, Project MPT-01 and is noted as a memo entry in the programs below.

(U) Program Accomplishments/Planned Programs:

	FY 2004	FY 2005	FY 2006	FY 2007
Structural Materials and Devices	(33.790)	42.271	49.000	48.617

(U) The Structural Materials and Devices program is exploiting emerging material science concepts and processing approaches to tailor the properties and performance of structural materials and devices to DoD requirements. Thrusts in this area include new concepts for ultra lightweight materials, amorphous and multi-functional materials for lowering the weight and increasing the performance of aircraft, ground vehicles, blast/ballistic protection and spacecraft structures. Approaches are also being developed for reducing the risk of introducing new materials in defense acquisitions and maintaining them in the field. Techniques are being established for assessing damage evolution and predicting future performance of the structural materials in Defense platforms/systems through physics-based models and advanced interrogation tools. New, low cost processing and fabrication techniques are also being developed to enable expanded use of new materials and structures in Defense applications as well as to produce novel materials that cannot be made through conventional processing approaches.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology PE 0602715E, Project MBT-01

(U) Program Plans:

- Develop multifunctional materials concepts designed to provide significant improvement in the capabilities of Defense systems by providing additional functions (e.g., self-healing, thermal control, blast protection, and power) to load bearing structures, quantify their performance and fabricate specific prototype systems.
- Develop a portable, low-logistics protective system to protect troops against shrapnel and blasts from improvised explosive devices.
- Develop and verify models that predict bulk amorphous metal formation and behavior; use these models to produce amorphous materials and coatings with superior properties (including increased fracture toughness and high strain rate behavior and long-term corrosion resistance in saline environment) over crystalline material.
- Demonstrate fabrication (forming, joining, etc.) technologies that yield bulk amorphous metals suitable for Defense applications, especially those that require high fracture toughness, even at high strain rates, and quantify the impact of using bulk amorphous materials in construction of land vehicles and naval vessels.
- Demonstrate and validate solutions to critical technical issues for the accelerated insertion of materials that will allow designers to cut the insertion time of new materials by over 50 percent using materials of high value to DoD (turbine metals, aircraft structures).
- Explore techniques for large volume, low cost synthesis and assembly of nanomaterials and nanotubes with controlled attributes that are suitable for high toughness fibers and reinforcements; demonstrate these reinforcement concepts in structural composites in Defense applications such as advanced blast and ballistic damage tolerance.
- Develop models, mathematical techniques and novel sensors that when integrated with sensor data will capture the physics of failure and behavior prediction in materials suitable for assessing in-situ damage accumulation and will also provide current state awareness and structural performance prediction for Defense systems.
- Demonstrate the use of flight information to predict life and failure of critical structural components.
- Demonstrate novel, cost effective processing routes for aerospace grade (low oxygen) titanium metal and alloys. Explore processing routes for other structural materials of interest to Defense.
- Demonstrate novel and reproducible process routes for directed, localized and controlled microstructure modification to achieve substantial improvements in structural material properties of interest to Defense, including bronze castings for Navy applications.
- Explore concepts and demonstrate materials technologies for large, ultra-lightweight and controllable space structures.
- Develop unique, three dimensional approaches for making and replicating materials and structures of interest to DoD.

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	FY 2004	FY 2005	FY 2006	FY 2007
Smart Materials and Actuators	(30.000)	36.059	40.000	40.000

(U) In this thrust, smart materials, sensors and actuators for the control of the aerodynamic and hydrodynamic behavior of military systems are being developed and demonstrated to increase performance and lower detectability of aircraft, helicopters, and submarines. "Intrinsically smart" materials that provide self-diagnosis and/or self-repair will be developed as well. Machines are being developed that will increase the individual soldier's physical capabilities by augmenting speed, strength, and endurance. New combinations of advanced materials, devices, and structural architectures are being developed to allow military platforms to morph or change shape to adapt optimally to changing mission requirements and unpredictable environments. New materials and devices will enable the military to function more effectively in the urban theater of operations.

(U) Program Plans:

- Design, demonstrate and validate an integrated, untethered, and self-powered exoskeleton system for augmenting the locomotion and strength of soldiers. The interface of the machine and human will be dramatically enhanced by the development of novel sensor architectures and control algorithms.
- Demonstrate capabilities of the exoskeleton against specific military metrics.
- Develop and demonstrate novel fluidic and mechanical devices, and their associated driving electronics that exploit smart material transducers in order to create new high power actuators for a variety of military applications.
- Develop, design and test the actuators, materials, and control architectures necessary for achieving precise shape change in an airframe to demonstrate the advantages and enable capabilities afforded by the ability to change shape (morphing).
- Extend morphing concepts to expand military capabilities of air vehicles, transatmospheric vehicles and orbiting systems including lightweight, reconfigurable optics.
- Develop ultra-light high temperature capable materials systems for hypersonic vehicles using novel approaches to enable reduced thermal load, boundary layer control and virtual shape control.
- Develop materials, devices, and systems for urban conflict including approaches for moving in the third dimension, compact, expandable barriers, tamper resistant or tamper evident door and window coverings, and traction reducing agents for impeding foot and wheeled traffic.
- Develop a rapidly deployable and reversible, portable lightweight barrier to control enemy mobility in urban areas such as intersections, alleyways, doorways, etc.

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	FY 2004	FY 2005	FY 2006	FY 2007
Functional Materials and Devices	(20.000)	33.000	40.790	37.000

(U) In this program, new materials and concepts are being applied to the development of functional materials and devices. A fundamental principle of this thrust is to design material microstructures at the scale appropriate to exploit fundamental interactions with the environment in order to create materials with unique properties. Among the materials being developed in this thrust are new permanent magnetic materials with significantly higher magnetic strength and higher operating temperature for motors, generators, flywheels, bearings and actuators. Unique multifunctional fibers that can be woven into fabrics are being developed. Engineered materials (metamaterials) are being developed that provide dramatically new electromagnetic behavior across the complete array of Defense applications. Also, the concept of pushing nanostructured materials into optical regimes to slow light and producing negative index materials promise to yield important new materials and devices for DoD.

(U) Program Plans:

- Develop and demonstrate novel magnetic meta-materials for DoD motor applications including: 1) high temperature, high strength soft magnetic materials for rotor and stator applications in turbine environments; and 2) permanent magnets with superior energy products.
- Develop and demonstrate novel microwave meta-materials that will enable novel antenna and radar designs with reduced size and improved bandwidth and efficiency.
- Develop smart, multifunctional fibers that may be woven into textiles to provide revolutionary capability for warfighter uniforms and equipment; for autonomous vehicles, and space structures.
- Develop and demonstrate novel materials that can be remotely switched between two stable electromagnetic and/or structural configurations, including munitions with controllable sensitivity.
- Extend the frequency of operation and/or operational bandwidth of “negative index” or “left handed” materials to demonstrate novel RF and optical applications for Defense.
- Develop new functional material amenable to slowing, storing and manipulating light.

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	FY 2004	FY 2005	FY 2006	FY 2007
Materials for Logistics (Air, Water, Power)	(28.852)	40.000	48.000	47.000

(U) This thrust will apply novel materials and structures to reduce the logistics burden of the warfighter in the field. New materials and concepts for increasing the availability of portable power to the soldier are being investigated, as are approaches for deriving power from the environment for soldiers and sensors. Novel approaches for direct energy conversion from thermal sources such as submarine nuclear reactors are also being examined. New materials and designs will also be applied to the development of novel mesoscale engines (e.g., Stirling, water-lubricated steam engines) that will provide needed power on the battlefield. Hybrid superconducting/cryogenic components will provide a new paradigm for power electronics for the "all electric" platforms of the future. Also, new hybrid concepts for long duration, unmanned underwater vehicles will be investigated along with the feasibility of open ocean, littoral and freshwater prototype fuel cell systems, capable of generating continuous, unattended electrical power for greater than 10 years. Other approaches to enzymatic based energy sources will also be examined as will unconventional power sources. Finally, materials technologies will also be employed in novel approaches for obtaining and purifying water in the field.

(U) Program Plans:

- Design, develop, and demonstrate portable power sources in the 20 Watt power range suitable for several mission scenarios including: 1) a 3 hour micro air vehicle reconnaissance mission; 2) a 3 day land warrior mission; and 3) a 10 day special operation forces mission.
- Develop and demonstrate enabling direct thermal to electric conversion technologies with potential for high (> 20%) conversion efficiencies and high (> 1 W/cm^2) power densities for DoD and commercial power generation applications.
- Demonstrate concepts for highly power-dense, man-portable kilowatt generators that will reduce the logistics burden for the soldier in the field.
- Develop and demonstrate in real military environment an efficient, low cost, 400 watt Stirling engine for Defense applications, including powering of small, motorized vehicles.
- Develop and demonstrate unique, energy-saving concepts for obtaining water from non-traditional sources (e.g. water-from-air), for the individual warfighter and small groups of soldiers.
- Demonstrate materials and components for a hybrid superconducting power system for a terrestrial (>5 MW) application that has high efficiency and reliability and the potential for significantly reduced size (10x) and weight (5x).
- Develop novel rectifying antenna approaches that will allow efficient beaming of power between spacecraft.

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- Demonstrate processes that can convert military waste to usable military logistic fuels.
- Design bioelectrocatalysts that are compatible to both the environment of the fuel cell, the electrolyte, and electron transport to the electrode.
- Develop sediment and water column fuel cell prototype systems; investigate systems concepts for hybrid powered surveillance platforms capable of maintaining a sustained presence, especially undersea or at high altitudes.
- Explore unconventional power sources that might yield new, efficient approaches to providing power to the battlefield.
- Establish the feasibility of using micro power sources for engineering and generating enzymatic and microbial catalysts for bio fuel cells (e.g., directed evolution).
- Establish techniques for suppression of neutron and gamma emission in compact alpha emitter nuclear power generators (a safety issue) and verify methods for suppression of radiation-induced damage in nuclear energy converter mechanisms.

	FY 2004	FY 2005	FY 2006	FY 2007
Heat Actuated Coolers	(1.200)	0.000	0.000	0.000

(U) Program Plans:

- Continued to develop compact, lightweight microtechnology-based cooling systems to take advantage of the availability of portable cooling in military and civilian applications where electric power is not available, but waste heat is plentiful.

	FY 2004	FY 2005	FY 2006	FY 2007
Friction Stir Welding	(1.200)	1.300	0.000	0.000

(U) Program Plans:

- Continue to investigate the applicability of using Friction Stir Welding to join amorphous alloys without recrystallization.

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	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Materials Research Institute	(1.800)	0.000	0.000	0.000

(U) Program Plans:
- Developed nano devices fabricated by bottoms-up fabrication techniques to form the basis for novel sensors and have the potential for information storage.

	FY 2004	FY 2005	FY 2006	FY 2007
Materials Science Technology	(0.750)	0.000	0.000	0.000

(U) Program Plans:
- Continued development of a training program for advanced composite materials by tailoring university and community college programs to industry needs.

	FY 2004	FY 2005	FY 2006	FY 2007
Strategic Materials	(4.250)	3.400	0.000	0.000

(U) Program Plans:
- Development continues on reliable, robust, repeatable, and cost effective Chemical Vapor Composite (CVC) SiC manufacturing process for high tech military, space, and industrial applications.

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	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Materials for Electromagnetic Devices	0.000	2.000	0.000	0.000

(U) Program Plans:
- Develop nanoscale mechanical spin switches using a unique nanofabrication capability.

	FY 2004	FY 2005	FY 2006	FY 2007
Cryo-Power Electronics Development for the All-Electric Ship Program	0.000	1.300	0.000	0.000

(U) Program Plans:
- Develop cryogenic electronics for the all electric navy through the establishment of a Cryogenic Electronics Center at Albany.

	FY 2004	FY 2005	FY 2006	FY 2007
MMI/MBI Nanotechnology Solutions	0.000	2.000	0.000	0.000

(U) Program Plans:
- Investigate new approaches and accelerate the research of leading-edge nano-scale technologies for potential Defense applications.

	FY 2004	FY 2005	FY 2006	FY 2007
Sematech	0.000	5.000	0.000	0.000

(U) Program Plans:
- Establish an advanced semiconductor prototyping capability for innovative micro-scale and nano-scale technologies.
- Develop approaches for processing and integration of soft and hard materials based on a silicon-centric platform.

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(U) Other Program Funding Summary Cost:

- Not Applicable.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Biological Technology PE 0602715E, Project MBT-02

COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Biologically Based Materials and Devices MBT-02	0.000	90.150	116.398	127.227	129.034	130.335	130.335	130.335

(U) Mission Description:

(U) This project acknowledges the growing and pervasive influence of the biological sciences on the development of new materials, devices and processes as well as the commensurate influence of materials, physics and chemistry on new approaches to biology and biochemistry. Contained in this project are thrusts in the application of biomimetic materials and devices for Defense, the development of biochemical materials to maintain performance, the use of biology's unique fabrication capabilities to produce structures that cannot be made any other way, the application of magnetic materials in biological applications, and the development of manufacturing tools that use biological components and processes for materials synthesis. This program element and project were created in accordance with congressional intent in the FY 2005 DoD appropriations bill. Prior year funding was budgeted in PE 0602712E, Project MPT-09 and is noted as a memo entry in each program below.

(U) Program Accomplishments/Planned Programs:

	FY 2004	FY 2005	FY 2006	FY 2007
Bioinspired and Bioderived Materials	(35.296)	40.000	40.000	44.000

(U) The Bioderived Materials thrust explores the application of biomimetic principles to materials and devices of interest to the DoD. Specifically, the unique characteristics of biologically derived materials and devices will be exploited through understanding, control and emulation of the structure and chemistry of the interface between man-made and biotic materials. This includes an effort to develop synthetic optics that mimics the advantages and adaptability of biological lenses. Other efforts seek to understand the principles of locomotion and sensing capabilities of biological organisms and implement them in man-made materials for robotics and other Defense applications. Also, the fundamental operating principles of biomolecular motors will be developed and exploited for designing nano- to macro-scale devices having unparalleled energy efficiency. Finally, the physical interfaces necessary for interacting and controlling biology will be developed and exploited.

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(U) Program Plans:

- Explore soft materials (e.g., actuators, adhesives) in biological systems for potential Defense applications.
- Demonstrate bio-inspired materials that manipulate troop-based chemical and electromagnetic emissions to increase troop survivability.
- Demonstrate biomimetic sensory prototypes and materials that collect electromagnetic olfactory and visual inputs.
- Develop sensors, inspired by certain biological organisms' ability to transmit and sense electromagnetic energy, for use as navigational and target discrimination/identification aides in maritime environments.
- Define new, malleable materials that utilize biomimetic principles of design (e.g., emulate skin, bone, muscle, nerve endings and self repair features) for locomotion and actuation.
- Explore new bioinspired locomotion in robotic systems and develop power efficient, systems level bio-locomotion for mobility in rough/loose terrain and in environments not usually used for locomotion, i.e., vertical (>60°) and inverted surfaces.
- Develop new biomimetically based swimming devices that will double the speed for SEALS while decreasing energy consumed by a factor of eight.
- Develop new materials that will allow the demonstration of lightweight, compact, bio-inspired optical devices. Demonstrations will include a 30X zoom lens of a size to fly on the Pointer unmanned air vehicle (UAV) and a variable field of view (90-180 degrees) lens that will fly on the Dragon Eye UAV.
- Determine and quantify the mechanism of motor function, motor performance, and efficiency for several types of biomolecular motors through computational models and experimental measurements.
- Demonstrate the utility of biomotors for specific DoD applications including high sensitivity biosensors, high efficiency solar cells and the emulation of natural muscle activity.
- Exploit stealthy sentinels, including the development of critical materials/device interfaces to address teleoperation and autonomous navigation, for their ability to be remotely guided to operationally relevant sites and generate environmental information (chemical, biological, and visual).
- Develop signal transduction technology that directly converts biological macromolecular activity (sensing/binding/conformation changes) into an appropriate electrical or optical signal output for the development of biomimetically-based sensors (uncooled IR, optical, etc.).
- Develop material systems based on biological principles that distribute the force and displacement capability of a hydraulic system continuously throughout a structure. Demonstrate these materials in systems that require large forces at moderate bandwidth such as helicopter blades.
- Adapt biologically inspired communication/sensing modalities to improve operations in extreme environments (jungle, urban).

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	FY 2004	FY 2005	FY 2006	FY 2007
Biochemical Materials	(24.000)	36.500	43.398	45.227

(U) The Biochemical Materials thrust examines how breakthroughs in the understanding of biochemistry can drastically improve the survivability of soldiers. For example, examining the biochemistry of the brain during sleep deprivation can lead to new approaches for maintaining the cognitive function of soldiers in the face of sleep deprivation. The application of biochemical principles can also lead to techniques to allow the principles of biological organisms that survive in extreme environments to be exploited for the preservation of tissue and cells of interest to DoD. Finally, understanding the biochemical behavior of organs and tissues, including the interaction of energy with biology, can lead to significant advances in the medical treatment of the soldier on the battlefield. This effort is supported by basic research on fundamental biological mechanisms in PE 0601101E, Project BLS-01.

(U) Program Plans:

- Demonstrate induced desiccation strategies for platelets and red blood cells that allow prolonged periods (> 24 months) of dry storage and recovery. Evaluate efficacy of the blood products in the battlefield environment.
- Develop self-care medical technology to enable the warfighter in the battlefield to accelerate wound healing, internal clotting and pain relief to increase a soldier's survivability on the battlefield.
- Develop an understanding of the biochemical and physiological causes of decreased cognitive performance during sleep deprivation through studying animal model systems, synaptic function, and transcranial magnetic stimulation (TMS).
- Demonstrate and validate approaches to develop biomaterials and other concepts that extend the cognitive performance capabilities of warfighters during extended periods of sleep deprivation and stress.
- Develop methods for maintaining functional and physiokinetic endurance by nutritional and physical methods that are rapidly inducible, reversible and minimize the need for caloric intake while maintaining both strength and endurance.
- Develop methods for regulating core body temperature and hydration to maintain physical performance and endurance when training.
- Demonstrate the capability to transfer biochemical processes chemically or physically to cells, tissues, organs, systems, and organisms lacking robust survival mechanisms.
- Develop an understanding of effect of non-lethal physical forces on biological responses, including traumatic brain injury.

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- Demonstrate full 3-D visual image representation carried on electronic dog tag that can be used to predict likelihood of survival from potentially lethal battlefield wound. Extend 3-D imaging approaches to a virtual autopsy capable of a more rapid and accurate post mortem wound assessment.
- Define and demonstrate new operating room technologies for the battlefield that reduce the needs for operating personnel.
- Develop devices to locate bleeding and stimulate the clotting process using acoustic energy.
- Develop methods for selectively reducing metabolic requirements in a reversible manner following injury in order to extend the period of survival from injury to initiation of treatment.

	FY 2004	FY 2005	FY 2006	FY 2007
Bio-Fabrication	(3.000)	3.500	6.000	10.000

(U) The Bio-Fabrication (B-FAB) program will demonstrate the feasibility of using biochemical processes as a new nanofabrication toolset to synthesize and manufacture chemicals, materials, and devices of high value to the DoD. A specific target for demonstration within this program is the development of highly efficient solar cells. Other targets for demonstration within this program include scalable technologies for opto-electronic materials and devices (GaN-InGaN-AlGaN and InP-GaP-AlP-AlInGaP materials; ultra-low-k dielectrics; Rf and photo-emissive devices), mechanical materials (super-tough fibers and associated composites), and site-directed-synthesis (in-package device fabrication). Key elements of this program include the development and utilization of biological components and/or processes for the fabrication of device-grade quality electronic/optical/mechanical materials, further development of these processes for electronic or optical doping, site-directed synthesis, and nanostructure process control, and finally the integration of the B-FAB process capabilities with current micro- and nano-fabrication tools for the fabrication of full-scale integrated electronic, optical, or mechanical proof-of-technology devices.

(U) Program Plans:

- Develop bioenabled routes for the fabrication of relevant electronic, optical, or structural materials. Demonstrate the essential capacity for the fabrication of the materials at the scale of interest (2-20nm range control).
- Develop computational, fabrication, and process control tools for the design, manipulation, and optimization of the bioprocess or bio-pathway with the target properties necessary for the fine-scale manipulation of bio-fabrication.

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- Develop and demonstrate the capability to produce bio-fabricated materials with chemically and/or spatially modulated properties, possibly including controlled doping (n-type, p-type), stacked nano-layers, quantum dots, or 3-D articulated structures in a candidate electronic, optical, or mechanical device material.
- Demonstrate the integrability of bio-fabrication processes with current fabrication and/or micro-fabrication toolsets.
- Design, develop, and demonstrate integrated bio fabricated electronic, optical, or mechanical devices with improved or otherwise unattainable performance or cost characteristics.

	FY 2004	FY 2005	FY 2006	FY 2007
Bio-Magnetic Interfacing Concepts (BioMagnetICs)	(8.514)	10.150	12.000	8.000

(U) The Bio-Magnetic Interfacing Concepts (BioMagnetICs) Materials program will develop and demonstrate novel capabilities for integrating nanomagnetics with biology and will demonstrate the advantages of magnetics as a powerful new transduction mechanism for detecting, manipulating, and controlling biological function in single cells and biomolecules. The state-of-the-art research "tools" that have allowed researchers to observe the most fundamental units of biology (cells, DNA, proteins, etc.) do not possess the resolution, precision, or high throughput capacity to enable manipulation and/or functional control of large numbers of cells and biomolecules. Such a capability would have a pervasive and paradigm shifting impact on future military and civilian applications of biotechnology including chem-bio detection, therapeutics, and medical diagnostics. Nanoscale magnetics offers the promise of a robust, non-invasive, non-destructive, multiplexing, and high throughput interface that is compatible with the nanometer scale at which the biochemistry of cellular function exists. This effort is supported by basic research on fundamental biological mechanisms funded in PE 0601101E, Project BLS-01.

(U) Program Plans:

- Develop and demonstrate a portable, magnetics-based DNA detection and readout capability for rapid determination of specific biological warfare agents.
- Develop and demonstrate a capability for non-invasive, non-destructive imaging of intracellular activity.
- Develop and demonstrate remotely addressable, magnetics-based biochemical sensors.
- Develop and demonstrate the capability to magnetically manipulate and actuate cellular functions such as apoptosis, reproduction, and gene expression.
- Develop and demonstrate the capability to use magnetics to rapidly filter biotoxins from humans.

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	FY 2004	FY 2005	FY 2006	FY 2007
Revolutionizing Prosthetics	(0.000)	0.000	15.000	20.000

(U) The goal of this program is to dramatically change the state of the art of prosthetics, moving them from crude devices with minimal capabilities to fully integrated, fully functional limb replacements. Current prosthetic technology generally provides only gross motor functions, with very crude approaches to control – essentially switches. This often makes it difficult for wounded soldiers to return to a normal life, let alone return to military service. The needed advances will be accomplished by exploiting the dramatic breakthroughs of the Human Assisted Neural Devices program (PE 0601101E, Project BLS-01) as well as advances in biointerfaces, structural and smart materials, microelectronics and MEMS, and information sciences.

(U) Program Plans:

- Demonstrate the ability to implement brain/neural control with sensory feedback in a control architecture that combines the kinetics and mechanics (degrees of freedom) of natural movement, including the realization of proprioception and reflex activity.
- Develop and demonstrate new materials and actuators that are both biocompatible and emulate form and function of natural biological limbs.
- Develop and demonstrate distributed microprocessors and sensors with required bandwidth and sensitivity.
- Develop and demonstrate new distributed power sources that greatly improve the longevity of limb operation.
- Develop and demonstrate new approaches to limb healing and prosthetic integration that will dramatically decrease healing time and/or discomfort wearing the prosthetic.
- Transition breakthrough technologies in control, healing, sensing, energetics, and design into prosthetic devices with performance approaching that of living limbs to the Veteran's Administration and Walter Reed Medical Center.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2005
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Biological Technology PE 0602715E, Project MBT-02

	FY 2004	FY 2005	FY 2006	FY 2007
University of Florida Biosensor/Biomotive Nano Technology	(1.700)	0.000	0.000	0.000

(U) Transitioned research into methodologies for designing, fabricating and demonstrating different kinds of novel bio-molecular assemblies that form transducing elements between chemical, electrical, optical and mechanical phenomena.

(U) Other Program Funding Summary Cost:

- Not Applicable.