Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force											Date: April 2022	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602102F / *Materials*							
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
Total Program Element	-	228.115	220.960	134.795	0.000	134.795	135.031	139.922	134.785	138.457	Continuing	Continuing
624347: *Materials for Structures, Propulsion, and Subsystems*	-	109.001	104.876	52.794	0.000	52.794	51.077	54.207	55.514	56.879	Continuing	Continuing
624348: *Materials for Electronics, Optics, and Survivability*	-	60.873	55.699	37.279	0.000	37.279	38.119	38.850	36.771	37.694	Continuing	Continuing
624349: *Materials Technology for Sustainment*	-	58.241	60.385	44.722	0.000	44.722	45.835	46.865	42.500	43.884	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, sustainability, availability, affordability, supportability, reliability, and survivability of current and future Department of the Air Force systems and operations. The program has three projects that develop: structural, propulsion, and sub-systems materials and processes technologies; electronic, optical, and survivability materials and processes technologies; and sustainment materials, processes technologies, and advanced non-destructive inspection methodologies. Efforts in the program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication. This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities.

Funds in this PE may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	237.847	113.460	0.000	0.000	0.000
Current President's Budget	228.115	220.960	134.795	0.000	134.795
Total Adjustments	-9.732	107.500	134.795	0.000	134.795
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	107.500			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-4.101	0.000			
• Other Adjustments	-5.631	0.000	134.795	0.000	134.795

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: 624347: *Materials for Structures, Propulsion, and Subsystems*		
Congressional Add: *Program increase - Certification of advanced composites*	14.741	0.000
Congressional Add: *Program Increase - High Performance Materials*	7.862	0.000
Congressional Add: *Program increase - classified additive manufacturing*	19.655	0.000
Congressional Add: *Program increase - ceramic matrix composites*	9.827	0.000
Congressional Add: *Program increase - thermal protection for hypersonic vehicles*	9.827	10.000
Congressional Add: *Program increase - born qualified additive manufacturing*	0.000	20.000
Congressional Add: *Program increase - high and ultra-high temperature ceramic-matrix composites for hypersonics*	0.000	10.000
Congressional Add: *Program increase - additive manufacturing of alloys*	0.000	10.000
Congressional Add: *Program increase - high energy synchotron x-ray research*	0.000	8.500
Congressional Add: *Program increase - maturation of carbon-carbon thermal protection systems*	0.000	5.000
Congressional Add Subtotals for Project: 624347	61.912	63.500
Project: 624348: *Materials for Electronics, Optics, and Survivability*		
Congressional Add: *Program Increase - Technology for Broadband Operation*	9.827	0.000
Congressional Add: *Program Increase - Deployable passive cooling*	4.913	5.000
Congressional Add: *Program Increase - Human monitoring capabilities*	9.336	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Program increase - nano-bio technologies for aeromedical and en route care*	0.000	10.000
Congressional Add: *Program increase - photonic radio frequency CM*	0.000	10.000
Congressional Add Subtotals for Project: 624348	24.076	25.000
Project: 624349: *Materials Technology for Sustainment*		
Congressional Add: *Program Increase - Coating Technologies*	9.827	0.000
Congressional Add: *Program increase - digital maintenance advisor demonstration for F-16*	0.000	5.000
Congressional Add: *Program increase - failure prediction in material models*	0.000	5.000
Congressional Add: *Program increase - stealth aircraft coatings research*	0.000	4.000
Congressional Add: *Program increase - coating technologies to reduce lifecycle costs*	0.000	5.000
Congressional Add Subtotals for Project: 624349	9.827	19.000
Congressional Add Totals for all Projects	95.815	107.500

Change Summary Explanation

Decrease in FY 2021 reflects adjustments to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force			Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / *Materials*	Project (Number/Name) 624347 / *Materials for Structures, Propulsion, and Subsystems*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624347: *Materials for Structures, Propulsion, and Subsystems*	-	109.001	104.876	52.794	0.000	52.794	51.077	54.207	55.514	56.879	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for aircraft, spacecraft, launch systems, and missiles to improve affordability, maintainability, and performance of current and future Department of the Air Force systems. A family of affordable lightweight materials is being developed, including metals, polymers, ceramics, metallic and nonmetallic composites, and hybrid materials to provide upgraded capabilities for existing aircraft, missile, and propulsion systems to meet the future system requirements. The project develops high-temperature turbine engine materials that will enable engine designs to improve turbine engine thrust-to-weight ratio, specific fuel consumption and affordability. 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 fielded operational systems. The project concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Ceramics and Composites	24.806	23.584	29.562
Description: Develop ceramic, polymer, polymer and ceramic matrix composites, and hybrid materials technologies for performance and supportability improvement in propulsion systems and high temperature aerospace structures.			
FY 2022 Plans: Continue to validate, demonstrate and mature new advanced processing methods, coating technologies, and behavioral life prediction concepts for current and future higher capability polymer and ceramic matrix composites. Continue in-depth analyses and assessment of severe environment durability of advanced composite systems via mechanical testing. Continue validating, developing, and testing the new ceramic and polymer matrix composite materials and processes with higher temperature capability for next generation propulsion systems and aerospace structures. Continue to advance and integrate the computational material science infrastructure for composite materials in tools to model, characterize, and accelerate the development and certification of advanced composite materials. Continue to verify and validate damage progression models on increasingly complex polymer matrix composite structural applications. Continue developing and validating newer testing and assessment methods on composite damage progression models for application in an engineering environment. Continue to develop and validate advanced materials to meet evolving requirements for structural hardening. Initiate development and refine modeling tools to link processing to performance of organic/polymer matrix composites and expand damage mechanics models to increasingly complex composite materials.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Continue to validate, demonstrate and mature new advanced processing methods, coating technologies, and behavioral life prediction concepts for current and future higher capability polymer and ceramic matrix composites. Continue in-depth analyses and assessment of severe environment durability of advanced composite systems via mechanical testing. Continue validating, developing, and testing the new ceramic and polymer matrix composite materials and processes with higher temperature capability for next generation propulsion systems and aerospace structures. Continue to advance and integrate the computational material science infrastructure for composite materials in tools to model, characterize, and accelerate the development and certification of advanced composite materials. Continue to verify and validate damage progression models on increasingly complex polymer matrix composite structural applications. Continue developing and validating newer testing and assessment methods on composite damage progression models for application in an engineering environment. Continue to develop and validate advanced materials to meet evolving requirements for structural hardening. Continue development and refinement modeling tools to link processing to performance of organic/polymer matrix composites and expand damage mechanics models to increasingly complex composite materials. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $5.978 million. Funding increased due to increased emphasis on affordable composites.			
Title: Metals ***Description:*** Develop lightweight and high temperature metallics, life prediction technologies, and metals processing technologies for increased affordability, durability, and reliability of Department of the Air Force systems. ***FY 2022 Plans:*** Continue to validate, demonstrate and implement advanced computation methods to support faster material development and characterization modeling. Continue to analyze relationships between microstructure, processing, properties, and performance of affordable metallic and high performance gradient metallic materials. Continue to validate integrated material/manufacturing and component analysis for life management and development of affordable structural metals and low cost processes. Continue to advance reliable affordable metallic structural components through computational methods. Continue to validate the value of integrated analytical tools in the optimization of design and certification of additively manufactured metallic components. Continue development of novel capabilities via metallic additive manufacturing to be used as an alternative process when applicable. Continue to develop and refine processing methods and affordable metals for low cost, attritable propulsion systems. Continue development of enhanced life management practices to incorporate effects of engineered residual stress. Continue research on application of advanced data science, artificial intelligence and machine learning on materials science problems. Continue research on engine life prediction. ***FY 2023 Plans:***	14.934	14.077	15.463

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Continue to validate, demonstrate and implement advanced computation methods to support faster material development and characterization modeling. Continue to analyze relationships between microstructure, processing, properties, and performance of affordable metallic and high performance gradient metallic materials. Continue to validate integrated material/manufacturing and component analysis for life management and development of affordable structural metals and low cost processes. Continue to advance reliable affordable metallic structural components through computational methods. Continue to validate the value of integrated analytical tools in the optimization of design and certification of additively manufactured metallic components. Continue development of novel capabilities via metallic additive manufacturing to be used as an alternative process when applicable. Continue to develop and refine processing methods and affordable metals for low cost, attritable propulsion systems. Continue research on application of advanced data science, artificial intelligence and machine learning on materials science problems. Continue research on engine life prediction. Completed development of enhanced life management practices to incorporate effects of engineered residual stress. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $1.386 million. Funding increased due to increased emphasis on novel capabilities via metallic additive manufacturing.			
Title: Thermal Protection Materials	4.593	3.715	4.657
Description: Develop and evaluate lightweight, active, adaptive, multifunctional, high temperature, and durable material systems for extreme environments and hypersonic applications. ***FY 2022 Plans:*** Continue to validate and mature processing methods for fabricating materials required for expendable hypersonic applications. Continue to validate, develop and refine unique experimental techniques to assess mechanical properties and time-dependent behavior. Continue to validate and demonstrate material properties and performance to meet design needs for control surfaces, leading edges, aeroshells, and apertures. Further the development of computational models to assess environmental degradation of materials in a hypersonic environment. ***FY 2023 Plans:*** Continue to validate and mature processing methods for fabricating materials required for expendable hypersonic applications. Continue to validate, develop and refine unique experimental techniques to assess mechanical properties and time-dependent behavior. Continue to validate and demonstrate material properties and performance to meet design needs for control surfaces, leading edges, aeroshells, and apertures. Continue development of computational models to assess environmental degradation of materials in a hypersonic environment. ***FY 2022 to FY 2023 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by $0.942 million. Funding increased due to increased emphasis in hypersonic materials and processes.			
Title: Pervasive and Affordable Metals Technologies ***Description:*** Develop and demonstrate affordable, novel high temperature powder processing materials/structures and additive metals technology concepts to enable future defense capabilities, air vehicle propulsion, and computational prediction models. ***FY 2022 Plans:*** Technical work in this effort completed in FY 2021. ***FY 2023 Plans:*** Initiate demonstration of affordable metallic turbine engine disks made via powder processing technologies through high temperature, aggressive environment testing. Initiate development of low cost, complex shape metallic components made through additive manufacturing for advanced weapon system component prototypes. Initiate development of computational methodologies that incorporate impact of surface residual stress on the ability to extend life and lower life cycle cost of air vehicle propulsion system components. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $3.112 million. Funding increased due to the re-initiation of this effort in FY 2023.	2.756	0.000	3.112
Accomplishments/Planned Programs Subtotals	47.089	41.376	52.794

	FY 2021	FY 2022
Congressional Add: Program increase - Certification of advanced composites ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not applicable	14.741	0.000
Congressional Add: Program Increase - High Performance Materials ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not applicable	7.862	0.000
Congressional Add: Program increase - classified additive manufacturing	19.655	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

	FY 2021	FY 2022
FY 2021 Accomplishments: Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not applicable		
Congressional Add: Program increase - ceramic matrix composites ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not applicable	9.827	0.000
Congressional Add: Program increase - thermal protection for hypersonic vehicles ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not applicable	9.827	10.000
Congressional Add: Program increase - born qualified additive manufacturing ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	20.000
Congressional Add: Program increase - high and ultra-high temperature ceramic-matrix composites for hypersonics ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Add: Program increase - additive manufacturing of alloys ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Add: Program increase - high energy synchotron x-ray research ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	8.500
Congressional Add: Program increase - maturation of carbon-carbon thermal protection systems	0.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	61.912	63.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force			Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / *Materials*	Project (Number/Name) 624348 / *Materials for Electronics, Optics, and Survivability*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624348: *Materials for Electronics, Optics, and Survivability*	-	60.873	55.699	37.279	0.000	37.279	38.119	38.850	36.771	37.694	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops materials technologies for the Department of the Air Force's Intelligence, Surveillance, and Reconnaissance (ISR), situational awareness, and low-observable systems and subsystems for aerospace platforms and munitions. This includes sensors for microwave, short, mid, and long-wave infrared (SWIR, MWIR, LWIR) detection and countermeasures devices used for targeting, electronic warfare, and active aircraft protection. 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. Materials for protection of aircrews, sensors, and aerospace structures from laser and high-power microwave directed energy threats are also developed. 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. The project develops novel materials for electromagnetic interactions with matter for electromagnetic pulse, high power microwave, and lightning strike protection. The project develops nanostructured and biological materials for aerospace structures, munitions, aerospace vehicle subsystems, and personnel.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Infrared Detector and Electromagnetic Device Materials	11.147	9.516	11.557
Description: Develop infrared (IR) detector and electro-magnetic device materials and processes technologies for performance, affordability, and operational capability of surveillance, tracking, targeting, and situational awareness systems for the Department of the Air Force.			
FY 2022 Plans: Continue advanced development, demonstration and validation of materials and processes for control and detection of electromagnetic radiation for Intelligence, Surveillance and Reconnaissance (ISR) technologies. Further the development, testing, and assessment of materials for use in high resolution imaging by electromagnetic radiation. Continue advanced demonstration of nanoscale materials, metamaterials, and models for use in producing detectors. Continue to utilize all aspects of computational materials science to improve performance prediction and reliability models, as well as analyzing quantum materials for aerospace applications. Continue specific development and demonstration of short wave infrared detector and hyper-spectral long wave infrared materials. Continue to verify and validate materials and processes for integration of radio frequency and optical signals as well as concepts for novel optical devices and components. Continue development of photonics for aerospace applications,			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
and demonstrate nanostructured materials for components to enable agile radio frequency capability. Continue development of techniques using quantum materials and processes. ***FY 2023 Plans:*** Continue advanced development, demonstration and validation of materials and processes for control and detection of electromagnetic radiation for Intelligence, Surveillance and Reconnaissance (ISR) technologies. Further the development, testing, and assessment of materials for use in high resolution imaging by electromagnetic radiation. Continue advanced demonstration of nanoscale materials, metamaterials, and models for use in producing detectors. Continue to utilize all aspects of computational materials science to improve performance prediction and reliability models, as well as analyzing quantum materials for aerospace applications. Continue specific development and demonstration of short wave infrared detector and hyper-spectral long wave infrared materials. Continue to verify and validate materials and processes for integration of radio frequency and optical signals as well as concepts for novel optical devices and components. Continue development of photonics for aerospace applications, and demonstrate nanostructured materials for components to enable agile radio frequency capability. Continue development of techniques using quantum materials and processes. Initiate development of software defined imaging receivers. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $2.041 million. Funding increased due to increased emphasis on low-cost sensor materials for Intelligence, Surveillance, and Reconnaissance (ISR).			
Title: Directed Energy Hardened Materials ***Description:*** Develop and demonstrate technologies to enhance the safety, survivability, and mission effectiveness of personnel, sensors, viewing systems, and related Department of the Air Force assets. ***FY 2022 Plans:*** Continue to analyze, validate and demonstrate the comprehensive generated data of materials and technologies to protect against directed energy threats. Continue to develop and demonstrate advanced optical limiter materials for damage protection, enhanced hybrid materials for advanced applications, and continue to assess the response of new materials for high-energy laser interactions. Continue developing novel approaches for integration of multimodal hardening into structures and devices. Continue to assess data, validate repeatability and utilize computational materials science to enhance multi-scale modeling for design of robust, reliable integrated protection. Continue development of proven selected advanced materials technologies to protect against nuclear flash blindness. ***FY 2023 Plans:*** Continue to analyze, validate and demonstrate the comprehensive generated data of materials and technologies to protect against directed energy threats. Continue to develop and demonstrate advanced optical limiter materials for damage protection, enhanced hybrid materials for advanced applications, and continue to assess the response of new materials for high-energy laser	12.807	9.210	11.184

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
interactions. Continue developing novel approaches for integration of multimodal hardening into structures and devices. Continue to assess data, validate repeatability and utilize computational materials science to enhance multi-scale modeling for design of robust, reliable integrated protection. Continue development of proven selected advanced materials technologies to protect against nuclear flash blindness. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $1.974 million. Funding increased due to increased emphasis on integrated directed energy protection systems.			
Title: Laser Source Materials ***Description:*** Develop materials to enable higher performance high power laser sources (quasi-Continuous Wave to Continuous Wave) with emphasis on laser output in the mid-InfraRed spectral region (2-5 microns). ***FY 2022 Plans:*** Continue to demonstrate and validate materials and process technologies to control and generate directed electromagnetic energy for survivability and other applications. Further demonstrate and model materials processes for controlling laser beam direction and focus with optical components, and materials for frequency conversion, high power optical isolators, mid-wave infrared laser sources and high power microwave sources for directed energy sources. ***FY 2023 Plans:*** Continue to demonstrate and validate materials and process technologies to control and generate directed electromagnetic energy for survivability and other applications. Further demonstrate and model materials processes for controlling laser beam direction and focus with optical components, and materials for frequency conversion, high power optical isolators, mid-wave infrared laser sources and high power microwave sources for directed energy sources. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $0.263 million. Funding increased due increased emphasis on high power optical isolators.	1.327	1.228	1.491
Title: Nanostructured and Biological Materials ***Description:*** Develop enabling and foundational biotechnologies for guidance and control, rapid tagging, tracking and identification of targets, bio-integrated electronics and sensing for the Department of the Air Force applications. ***FY 2022 Plans:*** Continue to validate and verify engineering, scientific and processing methods for nano and biological materials to address unique requirements for the Department of the Air Force human-machine integration and electronic components. Continue to explore	11.516	10.745	13.047

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
biotechnology to assess the impact of microbes and fungi on Department of the Air Force systems. Continue to study more robust and reliable materials and processes to optimize components for compact, flexible, stretchable multi-functional devices, and validate materials and process for functional additive manufacturing of electronic components. Continue to demonstrate methods to assess reliability and field resiliency of nano and biological materials and processes. Continue to support the Flexible Hybrid Electronics Institutes for Manufacturing Innovation and the NanoBio Manufacturing Consortium for collaborative teaming. Initiate agile materials for basing, infrastructure and expeditionary operations. ***FY 2023 Plans:*** Continue to validate and verify engineering, scientific and processing methods for nano and biological materials to address unique requirements for the Department of the Air Force human-machine integration and electronic components. Continue to explore biotechnology to assess the impact of microbes and fungi on Department of the Air Force systems. Continue to study more robust and reliable materials and processes to optimize components for compact, flexible, stretchable multi-functional devices, and validate materials and process for functional additive manufacturing of electronic components. Continue to demonstrate methods to assess reliability and field resiliency of nano and biological materials and processes. Continue to support the Flexible Hybrid Electronics Institutes for Manufacturing Innovation and the NanoBio Manufacturing Consortium for collaborative teaming. Continue development of agile materials for basing, infrastructure and expeditionary operations. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $2.302 million. Increased funding due to increased emphasis on materials and processes to enable human-machine teaming.			
Accomplishments/Planned Programs Subtotals	36.797	30.699	37.279

	FY 2021	FY 2022
Congressional Add: Program Increase - Technology for Broadband Operation ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not Applicable	9.827	0.000
Congressional Add: Program Increase - Deployable passive cooling ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	4.913	5.000
Congressional Add: Program Increase - Human monitoring capabilities	9.336	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

	FY 2021	FY 2022
FY 2021 Accomplishments: Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not Applicable		
Congressional Add: Program increase - nano-bio technologies for aeromedical and en route care ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Add: Program increase - photonic radio frequency CM ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Adds Subtotals	24.076	25.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force			Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / *Materials*	Project (Number/Name) 624349 / *Materials Technology for Sustainment*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624349: *Materials Technology for Sustainment*	-	58.241	60.385	44.722	0.000	44.722	45.835	46.865	42.500	43.884	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops materials and processing technologies to support operational Department of the Air Force mission areas by providing the ability to inspect the quality of delivered systems, transition more reliable and maintainable materials, establish a capability to detect and characterize performance threatening defects, characterize materials processes and properties necessary for materials transition, and provide 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Material State Awareness	16.896	14.482	15.653
Description: Develop Materials State Awareness technologies to identify and characterize materials and/or damage regardless of scale for managing the health of fielded structures, propulsion systems, and low-observable materials/structures, plus enabling advanced materials qualification for Department of the Air Force systems.			
FY 2022 Plans: Continue to validate and demonstrate non-destructive evaluation modeling capabilities and use these competencies to drive improvements in capability to detect, characterize and quantify damage in realistic aerospace structures and engine components. Continue to analyze approaches to address the variability inherent in aerospace systems and materials to quantify the impact of that variability on nondestructive inspection capability and reliability. Continue to validate advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Continue development and validation of damage state awareness approaches and methodologies for use on aerospace structures and engine components. Continue to improve methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of specialty materials that enables/ensures more affordable coatings assessment. Validate tools to improve characterization and failure modes of specialty multilayer coatings. Continue to develop automation and robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624349 / *Materials Technology for Sustainment*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Continue to validate and demonstrate non-destructive evaluation modeling capabilities and use these competencies to drive improvements in capability to detect, characterize and quantify damage in realistic aerospace structures and engine components. Continue to analyze approaches to address the variability inherent in aerospace systems and materials to quantify the impact of that variability on nondestructive inspection capability and reliability. Continue to validate advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Continue to improve methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of specialty materials that enables/ensures more affordable coatings assessment. Continue to validate tools to improve characterization and failure modes of specialty multilayer coatings. Continue to develop automation and robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization. Initiate development of miniaturized nondestructive evaluation/inspection capabilities. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $1.171 million. Increased funding due to increased emphasis on automation capabilities.			
Title: Production and Repair Technologies	12.551	10.759	11.628
Description: Develop support capabilities, information, and processes to resolve problems with materials in the production and repair of systems components and structures for the Department of the Air Force. ***FY 2022 Plans:*** Continue to develop and communicate to the field best practices to ensure repeatability of advanced materials and processes technology to repair and extend the life of Department of the Air Force systems. Further refine through demonstration the understanding of material durability and repair limits for emerging Department of the Air Force systems. Continue to advance the analysis and development of improved life cycle prediction test methods and techniques to understand effects of service environments, corrosion, residual stresses, and material processes on structural and functional materials. Continue to improve the service life of advanced materials, processes and designs for improved repair and maintainability and life cycle cost of outer mold line coatings, access panel treatments, and multifunctional systems. Continue to further advance specialty material affordability technologies and processes to reduce maintenance costs of specialty materials. ***FY 2023 Plans:*** Continue to develop and communicate to the field best practices to ensure repeatability of advanced materials and processes technology to repair and extend the life of Department of the Air Force systems. Further refine through demonstration the understanding of material durability and repair limits for emerging Department of the Air Force systems. Continue to advance the analysis and development of improved life cycle prediction test methods and techniques to understand effects of service environments, corrosion, residual stresses, and material processes on structural and functional materials. Continue to improve the			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
service life of advanced materials, processes and designs for improved repair and maintainability and life cycle cost of outer mold line coatings, access panel treatments, and multifunctional systems. Continue to further advance specialty material affordability technologies and processes to reduce maintenance costs of specialty materials. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $0.869 million. Increased funding is a result of increased emphasis on specialty material affordability.			
Title: Failure Analysis Technologies ***Description:*** Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis for the Department of the Air Force. ***FY 2022 Plans:*** Continue to perform and increase efficiency of quick response failure analyses and materials investigations. Further the development and investigate improved analysis techniques to determine and prevent root cause materials failure/degradation. Continue to develop and provide advanced materials and processing solutions to ensure warfighter systems availability and safety of flight. Continue to refine development of functional materials failure analysis capabilities. Continue to analyze and validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Continue to transition advanced test and characterization methods for analyzing electrical and structural failures of emerging materials. Continue development of new, more durable materials and protection for high power wiring technologies, and advanced materials. ***FY 2023 Plans:*** Continue to perform and increase efficiency of quick response failure analyses and materials investigations. Further the development and investigate improved analysis techniques to determine and prevent root cause materials failure/degradation. Continue to develop and provide advanced materials and processing solutions to ensure warfighter systems availability and safety of flight. Continue to refine development of functional materials failure analysis capabilities. Continue to analyze and validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Continue to transition advanced test and characterization methods for analyzing electrical and structural failures of emerging materials. Continue development of new, more durable materials and protection for high power wiring technologies, and advanced materials. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased compared to FY 2022 by $1.297 million. Increased funding is a result of increased emphasis on functional materials failure analysis.	18.967	16.144	17.441
Accomplishments/Planned Programs Subtotals	48.414	41.385	44.722

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	FY 2021	FY 2022
Congressional Add: Program Increase - Coating Technologies ***FY 2021 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2022 Plans:*** Not Applicable	9.827	0.000
Congressional Add: Program increase - digital maintenance advisor demonstration for F-16 ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Add: Program increase - failure prediction in material models ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Add: Program increase - stealth aircraft coatings research ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	4.000
Congressional Add: Program increase - coating technologies to reduce lifecycle costs ***FY 2021 Accomplishments:*** Not applicable ***FY 2022 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Adds Subtotals	9.827	19.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable.