Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force											Date: March 2023	
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 2022**	**FY 2023**	**FY 2024 Base**	**FY 2024 OCO**	**FY 2024 Total**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**	**Cost To Complete**	**Total Cost**
Total Program Element	-	214.878	275.945	142.325	0.000	142.325	141.219	139.242	142.809	154.490	Continuing	Continuing
624347: *Materials for Structures, Propulsion, and Subsystems*	-	144.168	169.294	54.318	0.000	54.318	54.637	56.068	57.392	62.495	Continuing	Continuing
624348: *Materials for Electronics, Optics, and Survivability*	-	42.792	57.279	39.593	0.000	39.593	39.209	40.097	40.979	43.679	Continuing	Continuing
624349: *Materials Technology for Sustainment*	-	27.918	49.372	48.414	0.000	48.414	47.373	43.077	44.438	48.316	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.

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 element may include necessary expenses to support the operation and maintenance of facilities to manage, execute, and deliver science and technology capabilities.

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 2024 Air Force	Date: March 2023
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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	220.960	134.795	135.031	0.000	135.031
Current President's Budget	214.878	275.945	142.325	0.000	142.325
Total Adjustments	-6.082	141.150	7.294	0.000	7.294
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	141.150			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-6.082	0.000			
• Other Adjustments	0.000	0.000	7.294	0.000	7.294

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2022	FY 2023
Project: 624347: *Materials for Structures, Propulsion, and Subsystems*		
Congressional Add: *Program increase - thermal protection for hypersonic vehicles*	9.827	0.000
Congressional Add: *Program increase - born qualified additive manufacturing*	19.655	10.000
Congressional Add: *Program increase - high and ultra-high temperature ceramic-matrix composites for hypersonics*	9.827	10.000
Congressional Add: *Program increase - additive manufacturing of alloys*	9.827	10.000
Congressional Add: *Program increase - high energy synchotron x-ray research*	8.353	9.000
Congressional Add: *Program increase - maturation of carbon-carbon thermal protection systems*	4.913	5.000
Congressional Add: *Program increase - additive manufactured ceramic matrix composites*	0.000	5.000
Congressional Add: *Program increase - catalytic architectures for ASCENT satellite maneuverability*	0.000	6.000
Congressional Add: *Program increase - computationally-driven next generation carbon composite material development*	0.000	5.000
Congressional Add: *Program increase - materials for high-energy fuels*	0.000	10.000
Congressional Add: *Program increase - modeling ultra high temperature materials for hypersonics*	0.000	10.000
Congressional Add: *Program increase - scanning and additive manufacturing*	0.000	1.500
Congressional Add: *Program increase - accelerated material development for high mach capabilities*	0.000	10.000
Congressional Add: *Program increase - disruptive alloy metals development*	0.000	10.000
Congressional Add: *Program Increase - Deployable passive cooling*	0.000	5.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force	Date: March 2023
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 2022	FY 2023
Congressional Add Subtotals for Project: 624347	62.402	106.500
Project: 624348: *Materials for Electronics, Optics, and Survivability*		
Congressional Add: *Program Increase - Deployable passive cooling*	4.913	0.000
Congressional Add: *Program increase - nano-bio technologies for aeromedical and en route care*	9.827	0.000
Congressional Add: *Program increase - photonic radio frequency CM*	9.827	0.000
Congressional Add: *Program increase - small satellite technology*	0.000	20.000
Congressional Add Subtotals for Project: 624348	24.567	20.000
Project: 624349: *Materials Technology for Sustainment*		
Congressional Add: *Program increase - digital maintenance advisor demonstration for F-16*	4.913	0.000
Congressional Add: *Program increase - failure prediction in material models*	4.913	0.000
Congressional Add: *Program increase - stealth aircraft coatings research*	3.931	0.000
Congressional Add: *Program increase - coating technologies to reduce lifecycle costs*	4.913	0.000
Congressional Add: *Program increase - transparency repair program*	0.000	4.650
Congressional Add: *Program increase - flexible conductive materials*	0.000	5.000
Congressional Add: *Program increase - electromagnetic protected advanced lightweight multifunctional materials*	0.000	5.000
Congressional Add Subtotals for Project: 624349	18.670	14.650
Congressional Add Totals for all Projects	105.639	141.150

Change Summary Explanation

The increase in FY2024 is due to increased emphasis in materials and processes for materials for system survivability in extreme environments and in characterization of materials for assessment and repair of damage from these environments.

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force			Date: March 2023
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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
624347: *Materials for Structures, Propulsion, and Subsystems*	-	144.168	169.294	54.318	0.000	54.318	54.637	56.068	57.392	62.495	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 2022	FY 2023	FY 2024
Title: Ceramics and Composites	46.606	35.512	27.263
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 2023 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. 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 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
Continue validating, demonstrating, and maturing 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 advancing and integrating the computational material science infrastructure for composite materials in tools to model, characterize, and accelerate the development and certification of advanced composite materials. Continue verifying and validating 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 developing and validating 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 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 decreased compared to FY 2023 by $8.249 million. Funding decreased due decreased 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 2023 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 research on application of advanced data science, artificial intelligence and machine learning on materials science problems. Continue research on engine life prediction. Complete development of enhanced life management practices to incorporate effects of engineered residual stress. ***FY 2024 Plans:***	27.819	18.576	18.490

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
Continue validating, demonstrating, and implementing advanced computation methods to support faster material development and characterization modeling. Continue analyzing relationships between microstructure, processing, properties, and performance of affordable metallic and high performance gradient metallic materials. Continue validating integrated material/manufacturing and component analysis for life management and development of affordable structural metals and low cost processes. Continue advancing reliable affordable metallic structural components through computational methods. Continue validating 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 developing and refining 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. Complete research on engine life prediction. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 decreased compared to FY 2023 by $0.086 million. Funding decreased due to the above plans.			
Title: Thermal Protection Materials ***Description:*** Develop and evaluate lightweight, active, adaptive, multifunctional, high temperature, and durable material systems for extreme environments and hypersonic applications. ***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 2024 Plans:*** Continue validating and maturing processing methods for fabricating materials required for expendable hypersonic applications. Continue validating, developing, and refining unique experimental techniques to assess mechanical properties and time-dependent behavior. Continue validating and demonstrating 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 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 decreased compared to FY 2023 by $0.141 million. Funding decreased due to the above plans.	7.341	5.594	5.453
Title: Pervasive and Affordable Metals Technologies	0.000	3.112	3.112

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
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 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 2024 Plans:*** Continue demonstration of affordable metallic turbine engine disks made via powder processing technologies through high temperature, aggressive environment testing. Continue development of low cost, complex shape metallic components made through additive manufacturing for advanced weapon system component prototypes. Continue 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 2023 to FY 2024 Increase/Decrease Statement:*** N/A			
Accomplishments/Planned Programs Subtotals	81.766	62.794	54.318

	FY 2022	FY 2023
Congressional Add: Program increase - thermal protection for hypersonic vehicles ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not applicable	9.827	0.000
Congressional Add: Program increase - born qualified additive manufacturing ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	19.655	10.000
Congressional Add: Program increase - high and ultra-high temperature ceramic-matrix composites for hypersonics	9.827	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023
FY 2022 Accomplishments: Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.		
Congressional Add: Program increase - additive manufacturing of alloys ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	9.827	10.000
Congressional Add: Program increase - high energy synchotron x-ray research ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	8.353	9.000
Congressional Add: Program increase - maturation of carbon-carbon thermal protection systems ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	4.913	5.000
Congressional Add: Program increase - additive manufactured ceramic matrix composites ***FY 2022 Accomplishments:*** Not applicable ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Add: Program increase - catalytic architectures for ASCENT satellite maneuverability ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	6.000
Congressional Add: Program increase - computationally-driven next generation carbon composite material development ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Add: Program increase - materials for high-energy fuels ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Add: Program increase - modeling ultra high temperature materials for hypersonics	0.000	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023
FY 2022 Accomplishments: Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.		
Congressional Add: Program increase - scanning and additive manufacturing ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	1.500
Congressional Add: Program increase - accelerated material development for high mach capabilities ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Add: Program increase - disruptive alloy metals development ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	10.000
Congressional Add: Program Increase - Deployable passive cooling ***FY 2022 Accomplishments:*** Not Applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Adds Subtotals	62.402	106.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force			Date: March 2023
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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
624348: *Materials for Electronics, Optics, and Survivability*	-	42.792	57.279	39.593	0.000	39.593	39.209	40.097	40.979	43.679	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 specialty coatings 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. This project develops materials for protection of aircrews, sensors, and aerospace structures from directed energy threats without impairing mission effectiveness. Nanostructured and biological materials are being developed for aerospace structures, munitions, aerospace vehicle subsystems, and personnel.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2022	FY 2023	FY 2024
Title: Infrared Detector and Electromagnetic Device Materials	5.649	11.557	12.274
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 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 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
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 utilizing 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 verifying and validating 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. Continue development of software defined imaging receivers. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by $0.717 million. Funding increased due to increased emphasis on sensor materials for Intelligence, Surveillance, and Reconnaissance (ISR).			
Title: Directed Energy Hardened Materials	5.468	11.184	11.878
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 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 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 2024 Plans:*** Continue analyzing, validating, and demonstrating the comprehensive generated data of materials and technologies to protect against directed energy threats. Continue developing and demonstrating 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 assessing data, validating repeatability, and utilizing computational materials science to enhance multi-scale modeling for design			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
of robust, reliable integrated protection. Continue development of proven selected advanced materials technologies to protect against nuclear flash blindness. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by $0.694 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 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 2024 Plans:*** Continue demonstrating and validating 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, and mid-wave infrared laser sources for directed energy sources. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by $0.093 million. Funding increased due increased emphasis on high power optical isolators.	0.729	1.491	1.584
Title: Nanostructured and Biological Materials ***Description:*** Develop enabling and foundational biotechnologies for guidance and control, resilient basing, bio-integrated electronics and sensing for the Department of the Air Force applications. ***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	6.379	13.047	13.857

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
devices, and validate materials and processes 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 2024 Plans:*** Continue validating and verifying 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 exploring biotechnology to assess the impact of microbes and fungi on Department of the Air Force systems. Continue studying more robust and reliable materials and processes to optimize components for compact, flexible, stretchable multi-functional devices, and validate materials and processes for functional additive manufacturing of electronic components. Continue demonstrating methods to assess reliability and field resiliency of nano and biological materials and processes. Continue supporting 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 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by $0.810 million. Increased funding due to increased emphasis on biologically engineered materials.			
Accomplishments/Planned Programs Subtotals	18.225	37.279	39.593

	FY 2022	FY 2023
Congressional Add: Program Increase - Deployable passive cooling ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	4.913	0.000
Congressional Add: Program increase - nano-bio technologies for aeromedical and en route care ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	9.827	0.000
Congressional Add: Program increase - photonic radio frequency CM ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	9.827	0.000
Congressional Add: Program increase - small satellite technology	0.000	20.000

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023
FY 2022 Accomplishments: Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	24.567	20.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force			Date: March 2023
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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
624349: *Materials Technology for Sustainment*	-	27.918	49.372	48.414	0.000	48.414	47.373	43.077	44.438	48.316	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 2022	FY 2023	FY 2024
Title: Material State Awareness	3.236	12.153	16.945
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 specialty materials, plus enabling advanced materials qualification for Department of the Air Force systems.			
FY 2023 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 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 2024 Plans: Continue validating and demonstrating 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.			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
Continue analyzing 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 validating advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Continue improving 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 validating tools to improve characterization and failure modes of specialty multilayer coatings. Continue developing automation and robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization. Continued development of miniaturized nondestructive evaluation/inspection capabilities. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by $4.792 million. Increased funding due to increased emphasis on automation capabilities.			
Title: Production and Repair Technologies	2.404	9.028	12.588
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 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 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 2024 Plans:*** Continue developing and communicating 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. Complete the advancement of the analysis and development of improved life cycle prediction test methods and techniques to understand effects of service environments, residual stresses, and material processes on structural and functional materials. Continue improving the service life of advanced materials, processes and designs for improved repair and maintainability and life cycle cost of outer mold			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
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 2022	FY 2023	FY 2024
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 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by 3.560 million. Increased funding is due to increased emphasis on materials and processes to extend service life and reduce life cycle cost of system.			
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 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 2024 Plans:*** Continue performing and increasing 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 developing and providing advanced materials and processing solutions to ensure warfighter systems availability and safety of flight. Continue refining development of functional materials failure analysis capabilities. Continue analyzing and validating advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Continue transitioning 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 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased compared to FY 2023 by $5.340 million. Increased funding is a result of increased emphasis on functional materials failure analysis.	3.608	13.541	18.881
Accomplishments/Planned Programs Subtotals	9.248	34.722	48.414

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624349 / *Materials Technology for Sustainment*

	FY 2022	FY 2023
Congressional Add: Program increase - digital maintenance advisor demonstration for F-16 ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	4.913	0.000
Congressional Add: Program increase - failure prediction in material models ***FY 2022 Accomplishments:*** Conduct Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	4.913	0.000
Congressional Add: Program increase - stealth aircraft coatings research ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	3.931	0.000
Congressional Add: Program increase - coating technologies to reduce lifecycle costs ***FY 2022 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2023 Plans:*** Not Applicable	4.913	0.000
Congressional Add: Program increase - transparency repair program ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	4.650
Congressional Add: Program increase - flexible conductive materials ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Add: Program increase - electromagnetic protected advanced lightweight multifunctional materials ***FY 2022 Accomplishments:*** Not applicable. ***FY 2023 Plans:*** Conduct Congressionally directed efforts.	0.000	5.000
Congressional Adds Subtotals	18.670	14.650

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2024 Air Force		Date: March 2023
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624349 / *Materials Technology for Sustainment*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

Not Applicable.