Advanced Materials Roadmap

Updated as of 16 February 2024

Legend (Text Font): Ongoing | Done | Target

OVERALL STRATEGIES

Facilities and Services
- Continuous support for ADMATEL and PATHS Center

Human Resources
- Increase awareness of Advanced Materials and Nanotechnology in STEM curriculum, and in industry and among consumers
- Send 10 researchers abroad to raise local talent to global standards by providing exposure and training in renowned research laboratories
- Establish programs to obtain visibility into industry needs and open channels for collaboration (e.g. internships, immersions)
- Introduce targeted training electives in Advanced Materials and Nanotechnology to promote employment readiness of graduates for certain industry applications
- Balik Scientist Program to consolidate resources and lead R&D and collaboration efforts in the field (through Advanced Materials and Nanotechnology Hub)
- Improve workforce preparation for opportunities with multinational partners

R&D Program / Project Needs
- Build and publish database with information regarding technology researches, publications, laboratories and equipment, and skills developed
- Partner with at least 10 entities for R&D applications and infrastructure co-development
- Various ongoing R&D projects on Advanced Materials
- Materials Informatics R&D

S&T Policy Initiatives
- Ensure communication of government policy incentives and benefits to stakeholders

R&D SOLUTIONS

VISION
Provision of enabling technologies for applications beneficial to society

2021
400M

Establishment of foundations of Advanced Materials

- Development of supercapacitors out of indigenous materials and waste/by-products.
- Development of supercapacitors energy storage and generation out of advanced materials (e.g., electrolytes).

2022
400M

Enhancing Material Performance

- Development of solid-state supercapacitors and high-capacity supercapacitors using better materials (conductive polymers, nanometal-oxides, lithium-air).
- Materials Informatics for manufacturing
- Plasma R&D
- Demonstration of functional supercapacitors using indigenous materials and waste/by-products.
- Initial prototypes of supercapacitor-based energy storage systems using advanced materials.

2023
350M

Development of sustainable materials

- Development of smart materials for biodegradable packaging
- Further development of smart materials for energy generation and storage.
- Development of composite supercapacitors from conductive polymer and nano metal-oxide composites. (moisture)
- Prototyping of solid-state supercapacitors with improved energy storage and performance.

2024
350M

- Adoption of advanced materials such as intermetallics, nanoclays, and smart fibers.
- Research and development of flexible solid-state, and composite supercapacitors for electronics manufacturing.
- Development of sensors for harsh environments, including materials like gallium oxides, nitrides, silicon carbides, and chemical and biosensors for occupational health and environmental monitoring.
- Research and development of graphene-based sensors.
- Further Developments on Plasma Technology R&D
- Development of smart materials for biodegradable packaging and anti-corrosion coatings ready for pilot production.
- Deployment of smart materials for energy generation and storage in real-world settings.
- Production of composite supercapacitors using conductive polymer and nano metal-oxide composites.'

2025
100M

- Nonwoven electrospun fibers incorporated for wound healing applications.
- Investigation into theranostic materials for imaging, simultaneous detection, and treatment.
- Development of biopolymeric substrates and their functional properties for enhanced material applications.
- Research into polymeric drug delivery packaging materials (syringe, etc.) for virology applications using locally sourced materials.
- Continued development of green coatings
- Successful integration of advanced materials (intermetallics, nanoclays, smart fibers) into existing applications.
- Deployment of flexible solid-state and composite supercapacitors in electronics manufacturing.
- Implementation of nonwoven electrospun fibers for wound healing.
- Prototyping and validation of theranostic materials for imaging and simultaneous detection and cure.
- Demonstrated use of biopolymeric substrates in 3D printing of custom implants.
- Initial production of biodegradable packing materials from coconut monoglycerides.
- Advancements in polymeric drug delivery systems for virology applications using locally sourced materials.
- Successful application of biodegradable anti-corrosion coatings in selected industries.

2026
100M

Continued R&D on other emerging materials (e.g aerogels, infinite recyclable plastics, metal-organic frameworks, reprogrammable inks/materials, room temperature superconductors, shape memory alloys, etc.)

Emerging Material Frontiers
- Successful integration of graphene-based sensors into smartphones.
- Development and production of ultrasound/piezoelectric micromachine ultrasonic transducers (PMUT) for the automotive industry.
- Deployment of sensors for harsh environments in occupational health and environmental monitoring.

2027
100M

Bio-inspired and Sustainable Materials

Continued R&D on bio-inspired sustainable materials (e.g. Bioceramics)

- Continued research and development of advanced materials, with a focus on bio-inspired and sustainable options.
- Advancements in the development and application of various advanced materials, including aerogels, atomic knots, bio-materials, and more.
- Prototypes and demonstrations of new materials in selected applications.

Advancement of Plasma Technology R&D

2028
- Full-scale integration of advanced materials research into existing solutions for sustainability.
- Widespread adoption of eco-friendly packaging solutions using biodegradable packing materials.

MILESTONES

OVERALL OUTCOME
Locally-developed products and services intended for wide-range of applications

List of Advanced Materials Projects (for the whole duration of the roadmap)

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Advanced Materials	SMART INK: Development of a 3D Printing Nano-Structured Carrageenan Hydrogel	13,164,213.66	3,046,679.36						Ongoing (DOST-GIA)
Advanced Materials	CYANanobot: Miniaturized Boat-assisted Data Acquisition for Automated Cyanide Monitoring in Wastewater using Optical Nano-sensor	4,891,339.13							Completed (DOST-GIA)
Advanced Materials	Building Bonds between Academe and Industry: Formulation of Vitrified Bonding Materials for Locally Manufactured Aluminum Oxide and Silicon Carbide Grinding Wheels	4,998,549.68							Completed (DOST-GIA)
Advanced Materials	CRADLE: Development of a Design Guideline Using Finite Element Analysis for Semiconductor and Electronics Packaging Systems for Automotive Applications (FEA2)	4,999,912.00							Completed (DOST-GIA)
Advanced Materials	Natural Fibers-based Hybrids Metal Ion Adsorbents by Fusing Multicomponent-reaction and Radiation-grafting of Polymers	1,237,110.00							Completed (DOST-GIA)

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		2022	2023	2024	2025	2026	2027	2028	
Advanced Materials	Advanced Surface Coatings for Lightweight Alloys Used in Aerospace Applications	3,320,552.28	3,342,753.24						Ongoing (DOST-GIA)
Advanced Materials	CRADLE: SPARCS: System for Plasma-assisted Ablation of Residues and Cleaning of Surfaces	879,874.68							Completed (DOST-GIA)
Advanced Materials	Building Bonds between Academe and Industry: Formulation of Vitrified Bonding Materials for Locally Manufactured Aluminum Oxide and Silicon Carbide Grinding Wheels	4,998,549.68							Completed (DOST-GIA)
Advanced Materials	AeroComp: Enhanced Lightweight Fiber-reinforced Composites Structures for Defense Applications	29,523,074.00	7,499,948.00						Ongoing (PCIEERD-GIA)
Advanced Materials	Development of Plasma Coating Processes for the Furniture Industry	968,060.80							Completed (DOST-GIA)
Advanced Materials	Computational modeling via Direct Simulation Monte Carlo method of laser ablation and plasma expansion—in relation to the deposited film characteristics on a substrate		780,440.00						Ongoing (PCIEERD-GIA)
Advanced Materials	CARRAGEEN RESEARCH & DEVELOPMENT LAB (CR&De-L): Developing Cold-Soluble Powders, Bioplastic Sheets, and Bioactive Hydrogels from Nano-Structured Carrageenans	1,771,141.35	846,604.20						Completed (DOST-GIA)

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R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Advanced Materials	Fabrication and characterization of plasma sprayed nanostructured TiO2-based coatings for photocatalytic applications	1,650,564.00							Completed (PCIEERD-GIA)
Advanced Materials	Fabrication and Characterization of Hydrophobic Nanocomposite Plated Abaca Fabric for Enhanced Electromagnetic Interference Shielding (EMI-SE) and Thermal Resistance (TR) for Spacesuits Application	3,022,064.56							Completed (DOST-GIA)
Advanced Materials	Irradiated Aquablocks Biofilm Carriers (i-ABC)			1,301,475.00	2,339,735.00	1,358,780.00			Ongoing (DOST-GIA)
Advanced Materials	Chemical Synthesis and Characterization of Conducting Polymer/Metal Nanoparticles Composites, and Their Application as a Chemiresistive Gas Sensor Array for H2S and CO2 (EDC Smart Sniffer)	1,473,234.00	214,548.00						Completed (PCIEERD-GIA)
Advanced Materials	baTID: RFID-band for Personalized Body Temperature Monitoring	4,998,296.40							Completed (DOST-GIA)