

Advanced Materials

Sector Roadmap
2014-2017

Materials for Sensors

Priority Areas

2014	2015	2016	2017
Synthesis of Sensor Materials (e.g. SMAs)	Sensor Design Using New Materials	Fabrication of Smart Sensors for Various Applications (e.g. heavy metal detection, high temperature SMA sensors to detect incidence of overheating/high temperature excursions)	Deployment, Evaluation, Testing Studies and Possible Scale Up Studies to Make Suitable for Large Scale Production
Sensors - Materials Development Potentiometric, Amphoteric, Photometric, Colorimetric, Spectroscopic, Thermochromatic sensors	Sensors - Device Design Demonstration (sensitivity, selectivity, reliability) Potentiometric, Amphoteric, Photometric, Colorimetric, Spectroscopic, Nitinol as sensing and actuating material	Sensors - Lab-scale Prototype Demonstration (scalability) Potentiometric, Amphoteric, Photometric, Colorimetric, Spectroscopic, Piezoelectric stretching sensor	Sensors - Lab-scale Prototype Demonstration (field deployable, integration) Potentiometric, Amphoteric, Photometric, Colorimetric, Spectroscopic, Touch sensitive material sensor
Sensors for Health, Water, Air, Soil, Food			

2014

2015

2016

2017

Chemical Sensors for Mine Site Monitoring Program

Project 1. Mapping of Heavy Metal Contamination in the Philippine Mining Soils Using Laser-induced Breakdown Spectroscopy (LIBS) Field Sensors

Project 2. Optical Sensors for the Determination of Zn and Cu in Ambient Water

Project 3. Gaseous Elemental Mercury Sensors for Atmospheric Monitoring

Project 4. Integrated Sensing System Using Mobile and Cloud Technologies for Mining and Nearby Communities

Project 5. Data Integration and Visualization of Sensor Output for Mine Site Monitoring

MECO-TECO: Synthesis and Characterization of Novel Metal Nanoparticle-doped Electroactive Polymer Materials and Their Possible Application for Gas Sensing

2014

2015

2016

2017

Sensors for Agricultural and Fishery Ecosystems and Harvests Safety (SAFEHarvestS) Program

Project 1. Development of Portable Surface Plasmon Resonance MIP-based Sensor for Detection of Histamine in Shrimps

Project 2. Development of Sensitive Prototype Sensor for Monitoring Insecticide Residues in Fruits and Vegetables to Address Current MRLs

Project 3. Development of Potentiometric-MIP Test Kit for the Detection of Clenbuterol in Meat

Project 5. The Development of Portable Detection Systems for Nitroimidazoles in Hog Urine and Piggery Run-off Water

Project 6. Molecularly Imprinted Polymer Modified-Carbon Paste Electrodes (MIP-CPEs) as Multi-analyte Sensor for the Detection of Organophosphorus Pesticides Chlorpyrifos and Fenitrothion and Triazine Herbicide Atrazine

Project 4. Development of Electrochemical Sensor Platform for Meat and Fish Freshness Monitoring

Coatings *(PVD and Plasma, Thermal Spray and Electrodeposition)*

Priority Areas

2014	2015	2016	2017
PVD Machine and Process for Surface Modification of Various Materials	Characterized MAX Phases for Decorative Colors and Functional Materials on Metal, Polymer, Alloy, Glass Substrates	Adherent Adhesive-free Metal Films on Surface Modified Polymers	Optimized and Robust Coating Processes for Various Applications
		Pulse Plating of Chrome and/or Alloy Coatings	Studies on Metal-oxide Composite Coatings via Electrodeposition
Heat Resistant Coated Materials	Antimicrobial Coated Materials	Self-cleaning Coated Materials	Anti-foul Coated Materials
Metallic Composite Coating by Electrodeposition for Structural/Industrial Applications			Pilot Scale Metallic Inorganic/Alloy Coating by Electrodeposition
Electrophoretic Superconducting Materials Coating	Large Area Electrophoretic Superconducting Coating		Superconducting Structures for Magnetic Shielding

Coatings *(PVD and Plasma, Thermal Spray and Electrodeposition)*

Actual Projects

2014

2015

2016

2017

Development of a Low-Energy Ion Source System for the Synthesis of Diamond-like Carbon Films

Physical Vapor Deposition of
Advanced MAX Phase
Materials

Fabrication of Metal Oxide
Thin films for Optical Coatings
with Plasma Assisted
Deposition Using a Plasma
Enhanced Chemical Vapor
Deposition (PECVD) System

High Throughput Processing
of Functional Thin Films Using
Gaseous Discharges

Project 1. Development of Direct
Current (DC) Magnetron Plasma
System for Ti-Al-C Thin Film
Synthesis

Project 2. Development of Radio
Frequency (RF) Plasma System for
Ti-Al-N Thin Film Synthesis

Advanced Polymers, Fibers, and Composites

Priority Areas

2014	2015	2016	2017
Indigenous Materials Properties Characterization	Processing of Composites for Target Applications	Optimization Studies and Prototyping for Novel Applications	New Applications for Natural Fiber-reinforced Composites
Biodegradable Polymers for Packaging	Antimicrobial Fibers	Surface Modified Conducting Polymers Using Ion Shower System	
	Plasma Treated Abaca Natural Fiber Composite for Industrial Applications (R&D)	Plasma Treated Abaca Natural Fiber Composite for Industrial Applications (Prototype product)	
Conducting Polymers for Solar Cell Applications	Ion-conductive Polymer Metal Composite Materials	Quantum Tunneling Composite Materials	Flexible Electronics
	Polymer for Fuel Cell Application	Polymer for Drug Delivery	

Green Materials and Remediation

Priority Areas

2014

2015

2016

2017

Develop and Characterize **Materials to Detoxify Harmful Substances in Water, Air, and Soil**

Membrane-based System for Water Treatment

Polymer for Environmental Application

Materials and Processes for Desalination

Removal and Decomposition of Water-soluble Oil Fraction by Photocatalysis

Development of Zeolite for Oil Spill Decontamination

Mineralization of CO₂ and Other Pollutants in the Atmosphere Using Mine Tailings and Other Mineral Sources for Cement Production

Development of Calcium Carbonate-chitosan Composite Membrane for Spill Treatment

Characterization of Carbonized Chicken Feathers for Hydrogen Storage, Heavy Metal Absorption, and Gas Cleaning System

Green Materials and Remediation

Actual Projects

2014

2015

2016

2017

**Development,
Characterization and
Performance Evaluation
of Polymeric Separation
Membrane for Industrial
Applications using Local
Materials (Phase 1)**

Electronics and Semiconductor Materials

Priority Areas

2014

2015

2016

2017

Semiconductor Materials

PN Diode (silicon, polysilicon, III-V), Schottky Diode (ZnO, TiO₂, Si, Ge), Heterojunction Diode (ZnO/Si, CuO/ZnO), Field Emission Transistor (III-V compound, spin, tunneling, ferro-electric)

Materials Development

Device Demonstration

Logic Circuit Demonstration

Electronics Device Fabrication

Contacts and Interconnects, Barriers and Dielectrics, Doping, Packaging, Deposition, Optoelectronics

Materials and Process
Development

Process Demonstration:

Contacts and Interconnects	Industry compatible
Barriers and Dielectrics	Ultra thin barrier, low-k dielectric
Doping	Selective
Packaging	Thermal management polymer
Deposition	Printed electronic devices
Optoelectronics	Cost-effective, power-efficient LEDs

Electronics and Semiconductor Materials

Priority Areas

2014

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2017

Organic Semiconductor Materials

Synthesis

Characterization

Prototype

Creation of New Organic
Materials

Material Recovery

Characterization of Metal
Components of Typical
Electronics and Semiconductor
Waste

Recovery of Cu in Powder Form
From Liquid Waste of Printed
Circuit Board Facilities

Recovery of Metals in Powder
Form From Solid Waste of the
Electronics and Semiconductor
Industry

Utilization of Recovered Metal
Powder for Various Applications

Superconducting Materials

Device Grade Superconducting
Films

Thin Film Superconducting
Device

Magnetic Imaging Device

Electronics and Semiconductor Materials

Actual Projects

2014

2015

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2017

**Angular Goos-Hanchen
Shift: An Optical
Phenomena for Ultra Thin
Film Thickness
Measurement**

**Conduction in Disordered Materials in the Low-Frequency
Region**

**Fabrication of Highly C-Axis
Oriented YBCO Thin Films
by Sedimentation
Deposition**

**Ultrafast MBE-grown
Terahertz Photoconductive
Antenna Devices**

Materials for Energy

Priority Areas

2014

2015

2016

2017

Superconductors

Basic Studies

Loss Studies in Superconducting Wires and Tapes

Superconducting Wires

Superconducting Transformer

Equip Labs to Characterize and Test Materials for Energy

Studies on Synthesis of Porous Metals

Local Studies on Liquid Electrode Material Systems (e.g. Mg and Sb)

Photovoltaics

Materials Development
a) DSSC cost-effective dyes, environment safe electrolyte, transparent electrode
b) Alternative materials and processes - focus on low cost, environment friendly, scalability

Device Demonstration From Developed Materials and Processes

Prototype Device Demonstration

Cost-competitive DSSC

Materials for Energy

Priority Areas

2014

2015

2016

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Silicon

Materials and Process and Testing Development

- a) Monocrystalline Si-PV - low cost processing at least 15% efficiency
- b) Polycrystalline Si-PV - low cost processing at least 10% efficiency
- c) Amorphous Si-PV - low cost processing at least 5% efficiency

Device Demonstration From Developed Materials and Processes

Prototype Device Demonstration

Cost Competitive Solar Cells Bulk

Alternative and Renewable

Materials Development

- a) thermoelectric
- b) piezoelectric
- c) salinity-gradient
- d) light weight wind-turbine material,
- e) corrosion resistant water turbine material

Device Demonstration From Developed Materials and Processes

Prototype Device Demonstration

Practical-scale Device Demonstration

Zeolite Filled Composite Membrane for Biogas Quality Improvement

Materials for Energy

Priority Areas

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Energy Storage Devices

Materials Development

- a) Supercapacitors - electrolytes, membranes, electrodes
- b) Hydrogen production - light induced hydrolysis
- c) Liquid batteries - electrolytes, membranes, electrodes
- d) Lightweight batteries - solid polymer electrolytes, membranes, porous electrodes

Device Demonstration From Developed Materials and Processes

Prototype Device Demonstration

Practical-scale Device Demonstration

Others

Plastics for Solar Cells

Supercapacitors for Photovoltaics

Superconducting Transformers

Materials for Energy

Actual Projects

2014

2015

2016

2017

A Graphene-Based Electrochemical Supercapacitor for Solar Cells

Fabrication of a Solid-State Rechargeable Li-ion Battery Using $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ as Solid Electrolyte for Energy Storage Applications

e-Asia JRP: Development of Functional Nanocarbon-Based Catalysts for Biomass Conversion Processes

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Biodegradable Materials

Testing of Biodegradable Packaging Materials: Materials Sources

Fabrication and Testing of Biodegradable Materials

Biodegradable Starch-based Packaging Films for Food Products

Biodegradable Polymers and Composites

Inhibitors

Moisture Inhibitor Materials

Corrosion Inhibitor Materials

Oxygen Absorber Materials

Packaging Materials/ Technology for Agricultural and Food Products

Actual Projects

2014

2015

2016

2017

**Development of a Cost-Effective Colorimetric
Packaged/Frozen Fish Freshness Sensor Using Food-
Compatible Materials**

Fabrication of Supercapacitors Using Indigenous Textiles as Electrode Materials

Biomaterials

Priority Areas

2014	2015	2016	2017
Studies on Local Raw Materials	Carbonate Apatite Coating Synthesis	Process Optimization Studies	Bioactive Material for Orthopedic Applications
	Hydroxy Apatite (HAp) Synthesis and Characterization		Material for Sutures and Wound Dressings
Biopolymers for Skin Graft		Biopolymers for Bone Remediation	
Studies on Local Raw Materials for Biocompatibility	Synthesis of Biopolymers Carbonate Apatite Coating Synthesis	Characterization of Biopolymers Biomaterials for Drug Applications	Polymer for Bio Mimicking

Computational Materials

Priority Areas

2014

2015

2016

2017

Construction of Database

Reported Material Properties of Selected Strategic Materials Relevant to the Local Industry

Focuses on Changes in Microstructure of Strategic Metals/Alloys

Advanced Materials Design

Training on Computational Methods in Advanced Materials Design
New computing methods, Set up of computing workstations

Special Applications to Advanced Materials Design
Cloud-based Computing Technologies

Special Applications to Advanced Materials Design
Application to Key Target Areas

Competency for Advanced Materials Design

Computational Materials Design

For Biofuel Production

For Hydrogen Storage

For Hydrogen Fuel Cell

For Drug Delivery

Emerging Fabrication Competency

Priority Areas

2014

2015

2016

2017

Preparation for Fab
Facility

Construction of
Cleanroom

Equip Fabrication

Center for Advanced
Materials Design and
Fabrication

Emerging Fabrication Competency

Actual Projects

2014

2015

2016

2017

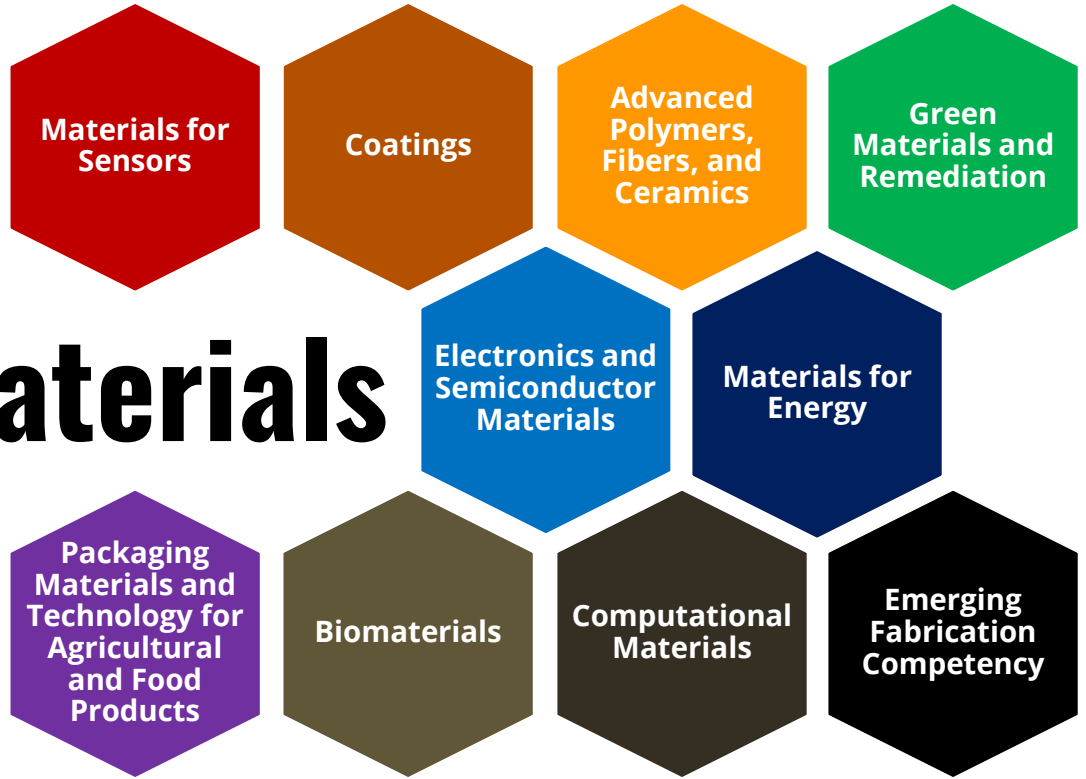
**Establishment of an Advanced Device and Materials Testing Laboratory
(ADMATEL)**

**Sustainability of
ADMATEL for the
Semiconductor and
Electronics and Other
Related Industries**

**Development of Physarum Polycephalum Powered
Actuators for a Microfluidic Mixer**

Project 1: Development of a Microgear Actuator Powered by
Physarum Polycephalum

Project 2: Development of a Hybrid Physarum Polycephalum
Controlled Micro-valve



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