

AREAS	2014	2015	2016	2017
Materials for Sensors	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 a) Potentiometric b) Amphoteric c) Photometric d) Colorimetric e) Spectroscopic f) Thermochromatic sensors - sensors for health, water, air, soil, food	Sensors - device design demonstration (sensitivity, selectivity, reliability) a) Potentiometric b) Amphoteric c) Photometric d) Colorimetric e) Spectroscopic f) Nitinol as sensing and actuating material sensors for health, water, air, soil, food	Sensors - lab-scale proto-type demonstration (scalability) a) Potentiometric b) Amphoteric c) Photometric d) Colorimetric e) Spectroscopic f) Piezoelectric stretching sensor sensors for health, water, air, soil, food	Sensors - lab-scale proto-type demonstration (field deployable, integration) a) Potentiometric b) Amphoteric c) Photometric d) Colorimetric e) Spectroscopic f) Touch sensitive material sensor sensors for health, water, air, soil, food
Coatings PVD and Plasma Thermal spray and electrodeposition (DC plating and pulse plating)	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; Pulse plating of chrome and/or alloy coatings	Optimized and robust coating processes for various applications 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 (surface modification) by Electrodeposition for structural/industrial applications (optimization of plating parameters)	Metallic Composite coating by Electrodeposition for structural/industrial applications (Surface characteristics and properties)	Metallic Composite coating by Electrodeposition for structural/industrial applications (prototyping)	Pilot scale metallic inorganic/alloy coating by electrodeposition
	Electrophoretic Superconducting Materials Coating.	Large Area Electrophoretic Superconducting Coating.		Superconducting Structures for Magnetic Shielding.

Advanced Polymers, Fibers and Composites	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; polymer for fuel cell application	Quantum Tunnelling Composite Materials; polymer for drug delivery	flexible electronics
Electronics and Semiconductor Materials	Ink formulations for printed electronic applications	Printed electronics design and testing of printing technologies	Printed electronics device prototypes	Printed electronic devices for target applications: sensors, energy storage, smart lables, etc.
	<p>Semiconductor Materials - materials development</p> <p>a) pn diode: silicon, polysilicon, III-V b) Schottky diode: ZnO, TiO₂, Si, Ge c) heterojunction diode: ZnO/Si, CuO/ZnO d) Field emission transistor: III-V compound, spin, tunnelling, ferro-electric</p> <p>Electronics Device Fabrication - materials and process development</p> <p>a) Contacts and Interconnects b) Barriers and Dielectrics c) Doping d) Packaging e) Deposition f) Optoelectronics</p>	<p>Semiconductor Materials - device demonstration</p> <p>a) pn diode: silicon, polysilicon, III-V b) Schottky diode: ZnO, TiO₂, Si, Ge c) heterojunction diode: ZnO/Si, CuO/ZnO d) Field emission transistor: III-V compound, spin, tunnelling, ferro-electric</p> <p>Electronics Device Fabrication - process demonstration</p> <p>a) Contacts and Interconnects b) Barriers and Dielectrics c) Doping d) Packaging e) Deposition f) Optoelectronics</p>		<p>Semiconductor Materials - demonstrate Logic circuits</p> <p>a) pn diode: silicon, polysilicon, III-V b) Schottky diode: ZnO, TiO₂, Si, Ge c) heterojunction diode: ZnO/Si, CuO/ZnO d) Field emission transistor: III-V compound, spin, tunnelling, ferro-electric</p> <p>Electronics Device Fabrication - process demonstration</p> <p>a) Contacts and Interconnects = Industry compatible b) Barriers and Dielectrics = Ultra thin barrier, low-k dielectric c) Doping = Selective d) Packaging = Thermal management polymer e) Deposition = Printed electronic devices f) Optoelectronics- cost-effective, power-efficient LEDs</p>

	Synthesis of Organic Semiconductor Material	Characterization of Organic Semiconductor Material	Prototype organic semiconductor material	Creation of new organic semiconductor material
		Device grade Superconducting Films	Thin Film Superconducting Device	Magnetic imaging device
	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
Materials for Energy				
1. Superconductors	Basic studies; Equip labs to characterize and test materials for energy	Loss studies in superconducting wires and tapes; Studies on Synthesis of Porous metals	Superconducting wires; Local studies on liquid electrode material systems (e.g. Mg and Sb)	Superconducting Transformer
2. 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
3. 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% eff c) Amorphous Si-PV - low cost processing at least 5% eff	Device demonstration from developed materials and processes	Prototype device demonstration	Cost competitive solar cells bulk
4. 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 (R&D Phase 1- Characterization of materials Formulation Studies)	Zeolite filled composite membrane for Biogas Quality Improvement - Prototyping and Validation of the membrane.	Demonstration/Installation of the membrane in an existing Biogas facility -scaling and performance/efficiency monitoring.
5. 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
6. Others	Plastics for solar cells	Supercapacitors for Photovolataics		Superconducting transformers
Packaging Materials/ Technology for Agri- and Food Products	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
	moisture inhibitor materials	corrosion inhibitor materials	oxygen absorber materials	
Biomaterials	Studies on local raw materials	Carbonate apatite coating synthesis; Hydroxy apatite (HAp) synthesis and characterization	Process optimization studies	Bioactive material for orthopedic applications; 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 biomimicking
	Develop and charcterize materials to detoxify harmful substances in water; polymer for environmental application	develop and characterize materials to detoxify harmful substances in air	develop and characterize materials to detoxify harmful substances in soil	Membrane-based system for water treatment; Materials and processes for desalination

Green Materials/ Materials for Remedation		Removal and Decomposition of water-soluble oil fraction by Photocatalysis; Mineralization of CO2 and other pollutants in the atmosphere using mine tailings and other mineral sources for cement production	Development of Zeolite for Oil Spill Decontamination; 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	
Computational Materials Design and Engineering - optimizing materials, manufacturing processes, and component design long before fabrication begins		Construction of database of reported material properties of selected strategic materials relevant to the local industry such as Cu-based and ferrous-based alloys (focus on mechanical properties, cost, corrosion resistance, electrical, thermal, compatibility with other materials, diffusion-related) - the output will be very useful for industry people without sufficient background in materials and will be useful in materials selection, design.	Construction of database which focuses on changes in microstructure of strategic metals/alloys via processing or heat treatment procedures and the corresponding reported changes in important properties, especially mechanical.	Competency for 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.	
	Computational Materials Design for Biofuel production	Computational Materials Design for Hydrogen Storage	Computational Materials Design for Hydrogen Fuel Cell	
Emerging Fabrication Competency	Preparation for fab facility	Construct cleanroom	Equip fab	Center for advanced materials design and fabrication