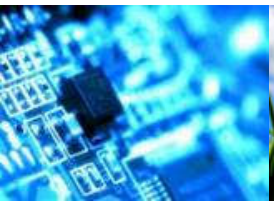
NATIONAL NANOTECHNOLOGY CENTER

THE LEADING AGENCY
ON NANOTECHNOLOGY DEVELOPMENT
IN THAILAND

สวทช NSTDA

NANOTEC
a member of NSTDA




NANOTEC

5 RESEARCH UNITS

Nanometrology & Characterizations and Engineering Unit

NCE

- Nano Characterizations Lab
- Nano Safety and Risk Assessment Lab
- Monitoring and Process Engineering Lab

Nano-Life and Health Research Unit

NLH

- Nano Delivery System Lab
- Nano-Cosmeceuticals Lab
- Nanomolecular Target Discovery Lab

Nanomaterials and Nanosystems Engineering Research Unit

MAT

- Integrated Nanosystem Lab
- Nanomaterials for energy and catalysis Lab
- Nanoscale Simulation Lab

Functional Nanomaterials and Nanofrontier Research Unit

FUN

- Functional Nanomaterials and Interfaces Lab
- Nanostructures and Functional Assembly Lab
- Nano Functional Textile Lab
- Nanofunctional Coating Lab

Nano-Agriculture and Environment Research Unit

NAE

- Nanoengineered Soft Materials for Green Environment Lab
- Nano Agro and Food Innovation Lab
- Hybrid Nanostructure and Nanocomposite Lab

Research & Development Management

Dr. Uracha Ruktanonchai
Deputy Executive Director
Research & Development

Dr. Pavadee Aungkavattana
Deputy Executive Director
Research & Development Support

Dr.Udom Asawapirom
NLH
Research Unit Director

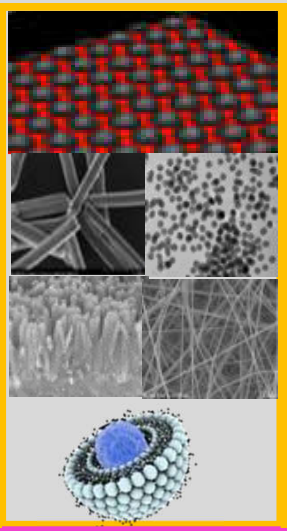
Dr.Varol Intasanta
FUN
Research Unit Director

Dr.Nuttaporn Pimpha
NAE
Research Unit Director

Dr.Kajornsak Faungnawakij
MAT
Research Unit Director

Dr. Wiyong Kangwansupamonkon
NCE
Research Unit Director

NANOTEC CORE TECHNOLOGY

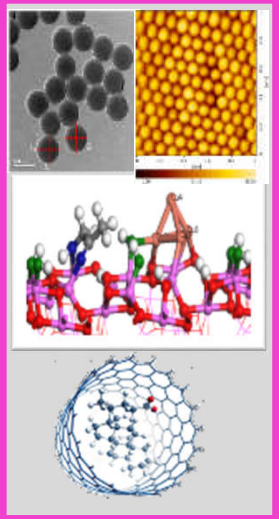


NANO Processing

- Encapsulation
- Nanocoating
- Nanomaterials modification and assembly
- Membrane separation
- 3D/4D printing
- Nanofiber

NANO Devices & Systems

- Fabrication
- Integration
- Separation
- Microfluidic
- Nanopore
- Microneedle

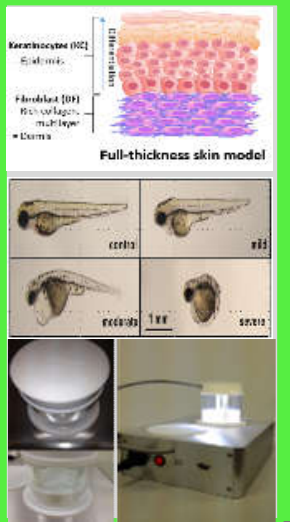


NANO Materials

- Design & Quantum Simulation
- Synthesis & Functionalization
  - Nanofibers
  - Metal/ Metal Oxide Nanoparticle
  - Bio-inspired
  - Synthetic & natural polymeric Nanoparticle
  - Hybrid & Composites
  - Catalysts

NANO Characterization & Standardization

- Sample preparation & nano-characterization
- Reliable *in vitro* 3D models for toxicological studies.
- *In vivo* models (zebrafish) and microorganisms



Nano-Life and Health Research Unit

Research and development goal is to enhance human and animal health. This cluster consists of 3 research programs: Nano-Molecular Target Discovery focuses on the design and development of molecules for targeting purposes with main applications in medical diagnostics. Nano Delivery System emphasizes the use of nanotechnology for encapsulation, controlled release and target delivery of drugs, biopharmaceutical agents including bioactive compounds, in order to improve the effectiveness for prevention and treatment. Nano-cosmeceutical focuses on the delivery system in novel cosmeceuticals from Thai natural resources.

- Nanomolecular Target Discovery (TDI)
- Nano Delivery System (NDS)
- Nano-Cosmeceuticals (NCM)

Research Highlights

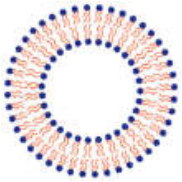
SugarAL GO sensor

Oral delivery of tilmicosin antimicrobial agent

Niosome Makam Pom Whitening facial cream

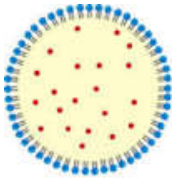
NANO ENCAPSULATION

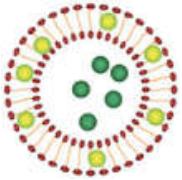
Nano-Encapsulation technology



Liposome

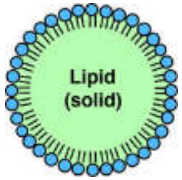
Nanoemulsion





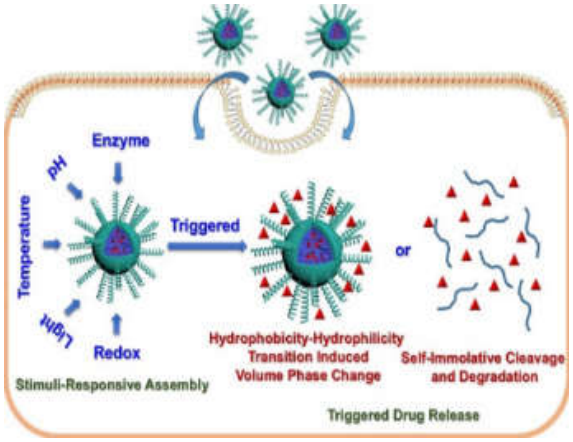
Niosome

nanoparticles



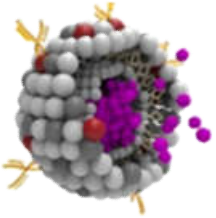
Polymeric nanoparticles

Stimuli-responsive nanocarrier technology

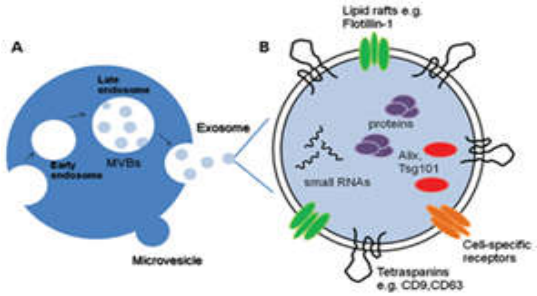


Stimuli factor:
Enzyme, Light,
Temperature, pH

Targeting Technology



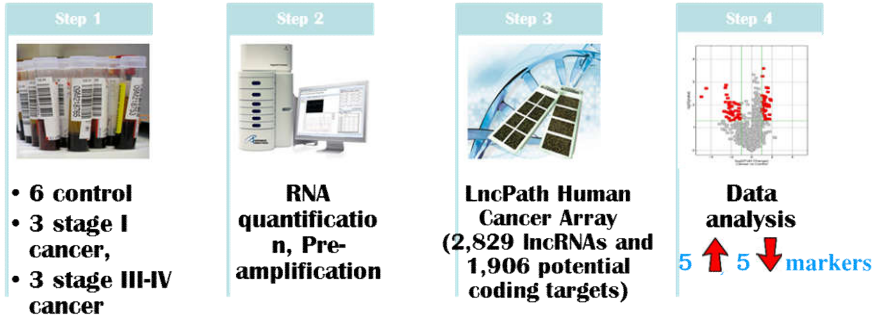
Nanomedicine
in cancer therapy



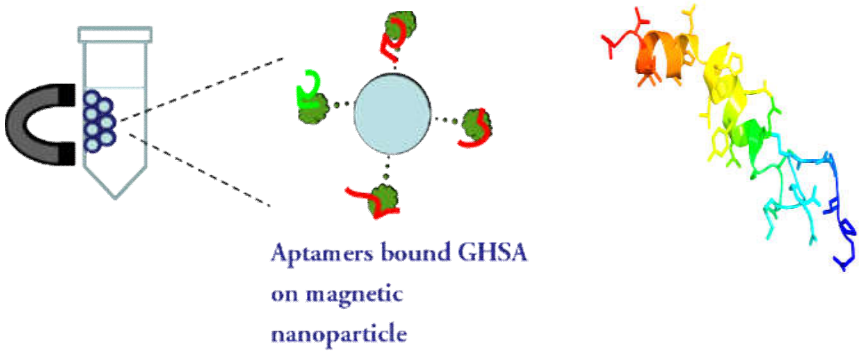
Nanomedicine for Blood
Brain barrier Delivery , BBB

Diagnostic capability

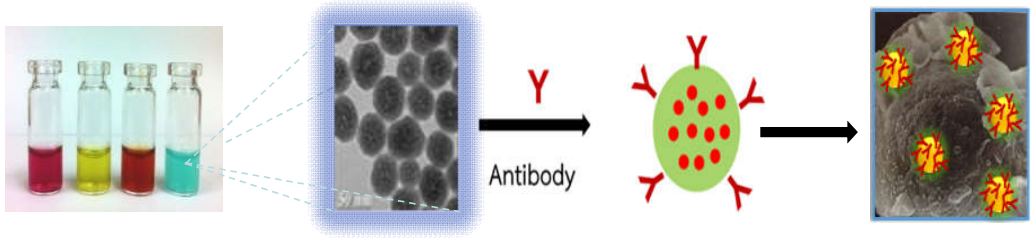
1) Biomarker discovery



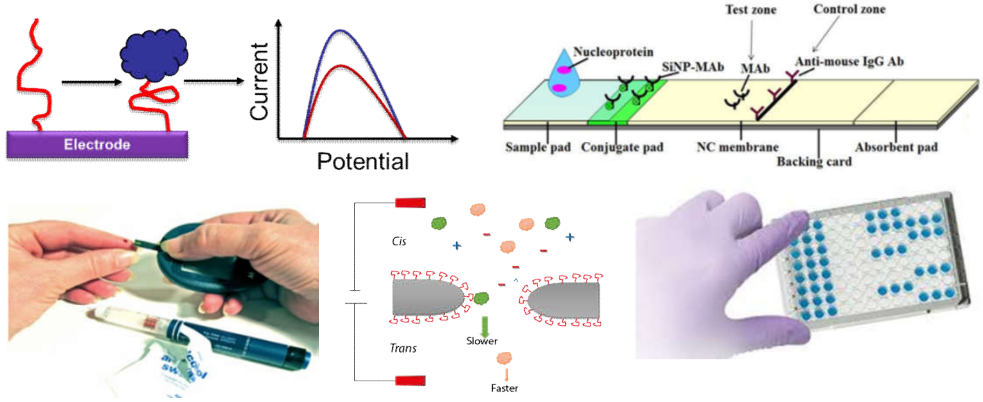
2) Development of targeting molecules



3) Synthesis and functionalization of nanoparticles for target detection



4) Development of diagnostics platforms



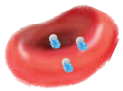
Aptasensor for diabetes mellitus screening and monitoring

Diabetes Mellitus in Thailand

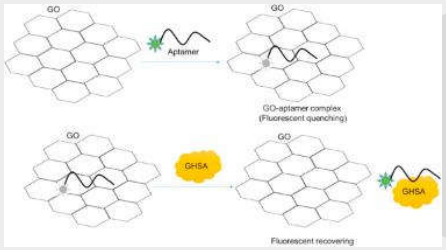
- 6.9% or 4.2 M are Diabetes Mellitus
- 30-40% or 24 M are Thalassemia carriers

DM diagnostics in Thailand

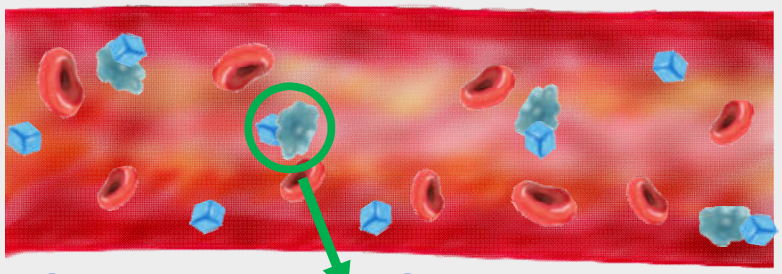
- Blood sugar ----> Depending on food intake
- HbA1c ----> No consistent in Thalassemia and thalassemia carriers



Solution



- Intermediate DM marker outside red blood cells
- Fasting is no required



Glycated Human Serum Albumin!!!

SugarAL GO sensor

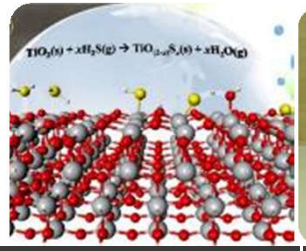
- **Simple**
- **Accurate**
- **Cheap**

Nanomaterials and Nanosystems Engineering Research Unit

Research and development on synthesis chemistry, fabrication&integration techniques, advanced characterization, scaled-up engineering and theoretical calculations to achieve improved design, and utilization of nanomaterials and nanosystems for energy, environment, and medical applications.

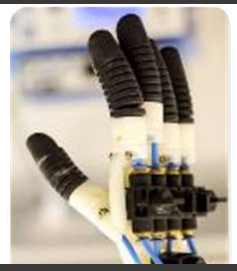
- Integrated Nanosystem (INS)
- Nanomaterials for Energy and Catalysis (NEC)
- Nanoscale Simulation (SIM)

Research Highlights



Quantum Simulation & Modelling

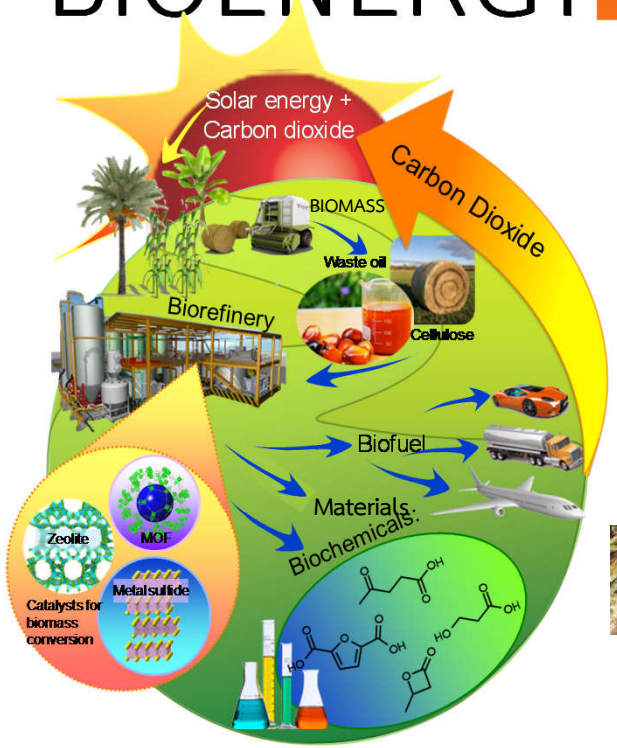
Nano-Catalysts & Carbons for Biorefinery & Oleochemicals



Soft Robotics

White-light Colposcope for Cervical Cancer Diagnosis

BIOENERGY : CATALYST




Water hyacinth

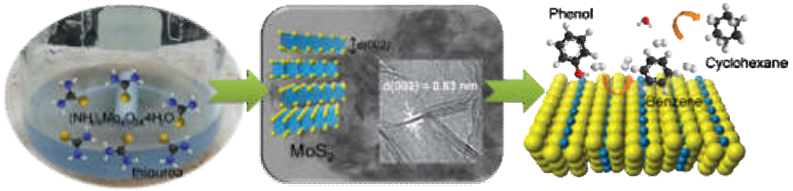

Bagasse


Egg shell

Catalyst and materials design by quantum simulation

Synthesis & Formulation

Up scaling to Mass Production



Low-cost synthesis of MoS_2 for hydrodeoxygenation of phenol (by organosulfur solution processing)

$ Green Diesel; $ Biodiesel; $ Biojet Fuel

$ Biogas Upgrading; $ Glycerol Utilization

28 IPs filing, including 2 IPs licensed

11 Collaborative/Contract Projects with Private Companies

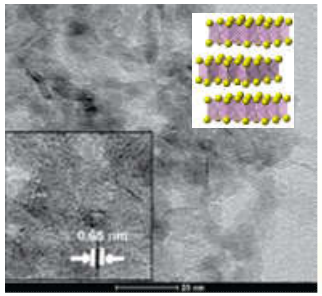
Int. Partners

- Kyoto University, JAPAN (JASTIP Program on Innovations in Biomass Application for Catalytic Material Synthesis and Energy Devices)
- Institute for Molecular Science (IMS), National Institutes of Natural Sciences (NINS), JAPAN (Biomass Application for Catalytic Material Synthesis)

APPLICATIONS : CONTRACT R&D & Tech Transfer

Development of Catalysts and Systems for Production of New Diesel Substitutes at Pilo

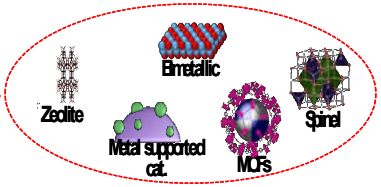
New formulation of **metal sulphide catalysts** has been developed from lab-scale process to pilot-scale one. The catalysts have been applied in the catalytic production of new diesel substitutes derived from bio-based feedstocks.

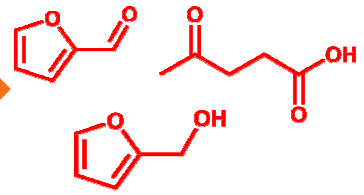


Current status: Fabrication of pilot plant is underway under the contract projects (>6.4 Million YEN)
2 IPs licensing: Application no.: 1401001337; 1401001338

Biomass pretreatment and conversion to value-added biochemicals

The green biomass pretreatment processes, including Hydrothermal and Steam explosion have been developed by using baggas. The resulting materials have been further converted to value-added chemicals such as sugars, furans, and organic acids using nanocatalysts.





Spinel nanocatalyst/
Nanoporous catalyst

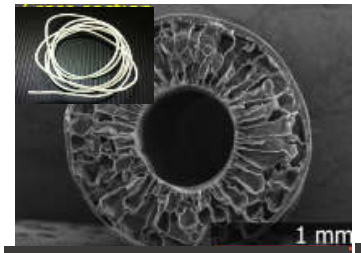
Current status: Process up-scaling under the Cellulosic Sugar Technology Development Contract Projects (5.12 Million YEN)

Nano-Agriculture and Environment Research Unit

Research and development on innovative food, agriculture and environment with the application of nanotechnology to modify materials, structures and surfaces for strengthening economics and social cooperation, and promote environmental sustainability. These include high value- added products, to minimize the usage of natural resource and toxic chemicals as well as to reduce the emission of waste and pollutants throughout the entire production and consumption processes.

- Hybrid Nanostructure and Nanocomposites (HNN)
- Nano Agro and Food Innovation (NAF)
- Nanoengineered Soft Materials for Green Environment (SOF)

Research Highlights



Nanofiltration hollow fiber membranes

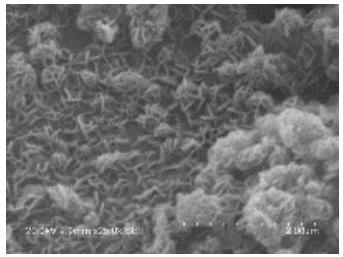
Self-emulsifying delivery system of sweet basil and oregano oil

Controlled release fertilizer

Solar operating system for water purification

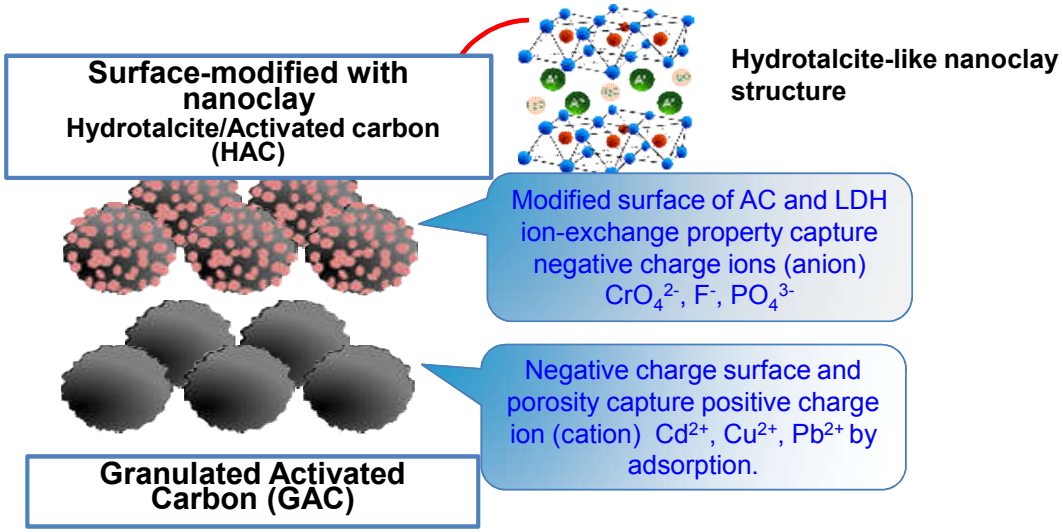
Nanocomposite : Nanoclay-Activated Carbo

Developed to surface-modified activated carbon with layered double hydroxide (LDH) or nanoclay.



Activated carbon with nanoclay surface.

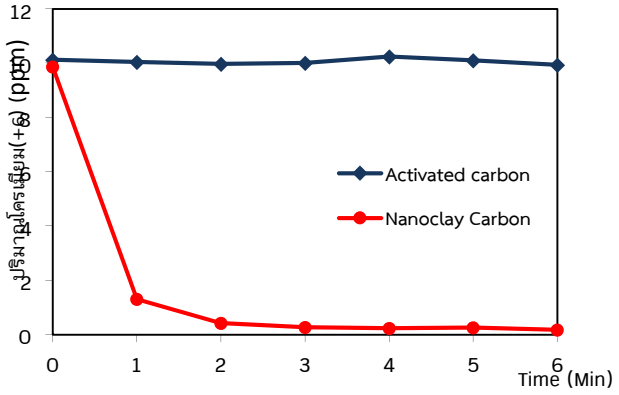
Specific surface properties	Measured values
Surface area	1033 m^2/g
Pore size	2.36 Å
Pore volume	0.61 cc/g
Iodine no.	984 mgI_2/g



Results of heavy metal adsorption and other anions

Ion	Removal (%)
Cr^{6+}	97.2
Cd^{2+}	67.3
Cu^{2+}	82.8
Ni^{2+}	41.5
Pb^{2+}	87.9
Mn^{2+}	35.5
Fe^{2+}, Fe^{3+}	98.9
PO_4^{3-}	73.3
F^-	77.1

Example graph for the decrease of CrO_4^{2-} by the adsorptions on two different adsorbents.



Overall LDH technology

Remediation

mazuma
Innovation For Your Quality Life

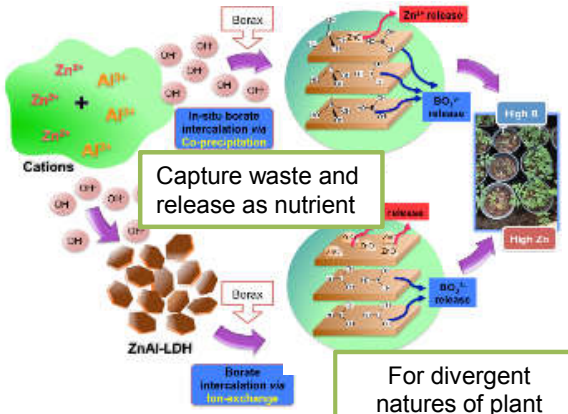
Licensed partner

SOS water 2 module Engineering & Electronics & IT

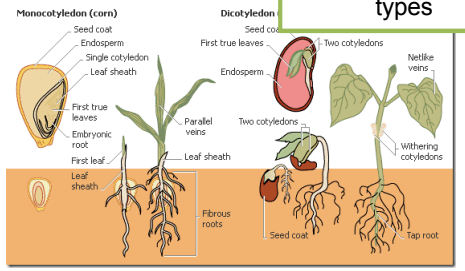
Specification	SOS water 2 filtration system
1. Process	7 steps
2. nanofiltration	Ceramic nanosilver filter Carbon nanoclay filter
3. Output	300 Liter per hour
4. Dimension	60 cm x 80 cm x 120 cm
5. Power	AC 220 V, Solar cell, Battery 12 V
6. Operation	Automatic
7. Control	AI and remote access

Technology transfer to R&D and production unit

Agriculture



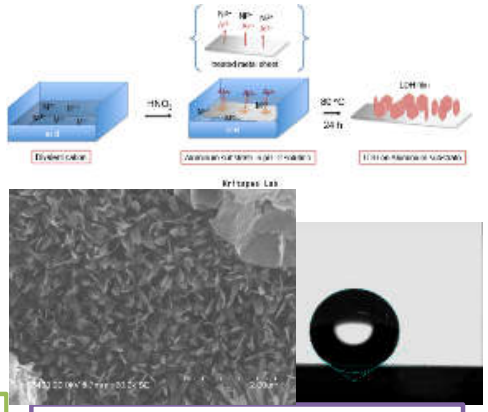
Capture waste and release as nutrient



For divergent natures of plant types

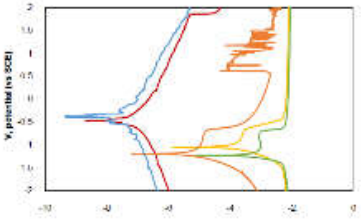
Treatment	Dry mass (g)	P (mg/L)	K (mg/L)	B (mg/L)	Zn (mg/L)
	0.07±0.0	24.2±2.4	269.0±27	0.2±0.2	1.9±0.8
	0.07±0.0	23.9±5.5	252.0±28	0.2±0.0	1.5±0.3
	0.18±0.1	67.3±43.2	539.0±341	1.1±0.3	3.0±1.3
	0.25±0.2	116.6±89.9	2163±1026	1.3±0.7	6.1±2.4
	0.44±0.1	243.3±24.7	3570±921	1.9±0.9	16±6.9
	0.75±0.3	394.4±208.7	4981±1787	3.2±1.2	15±3.9

Protection



150 degree super-hydrophobic metal

Water drops on Al plate



EIS for Anti-corrosion check!!!

Functional Nanomaterials and Nanofrontier Research Unit

Research and development on *molecular engineering (synthesis, functionalization and encapsulation) of responsive materials*. The second aspect expands across nanostructure & functional assembly for innovative design, synthesis and assembly of functional nanomaterials for applications in (bio) chemical sensing/imaging and optoelectronics. These developed nanomaterials that have special features and which focuses on specific application areas such as textile and household products, including the use of natural resources to improve quality of life.

- Functional Nanomaterials and Interfaces (FNI)
- Nano Functional Textile (NFT)
- Nanostructures and Functional Assembly (NFA)
- Nanofunctional Coating Lab (NFC)

Research Highlights

Single-step multiple coating technology for textiles

Ripeness indicator for fruits

transparent superhydrophobic coating

Flexible solar cell development

NANOCOATING

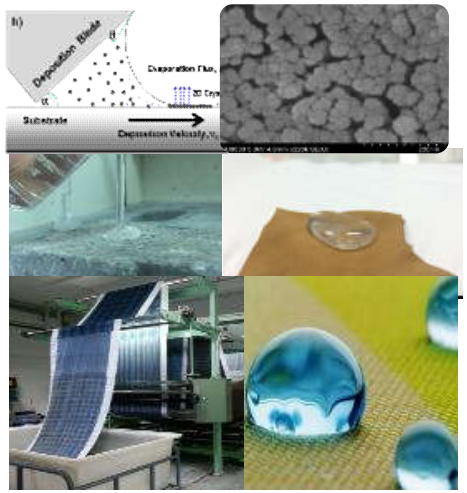
- Nanocoating for Durability Improvement
- Nanocoating for Functional Fibers and Textiles
- Grinding and Nano-dispersion for Stabilized Functional Nanoformulation
- Syntheses of Functional Materials for Smart Nanocoating

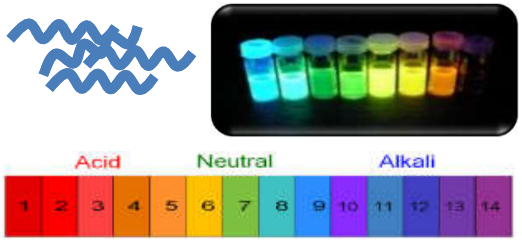
Superhydrophobic hard coating
Nanoparticulate assembly for functional surface
Transparent nanocoated protective layer

Single-step coating
Multi-component formulations
Multifunctional textiles
Materials stability

Continuous wet bead milling for grinding and dispersion
Encapsulation and surfactant-assisted dispersion.

Functional polymers
Responsive Molecules modifications
Thermochromic materials
Encapsulated active materials





APPLICATIONS : COMMERCIAL PRODUCTS

Nanocoating for Durability Improvement

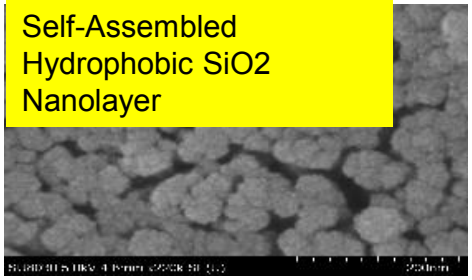
Development of functionalized nanomaterials and improve coating technique to achieve desired properties and functions

Solar Absorber Coating

Graphene/SiO2 Nanocomposite coating

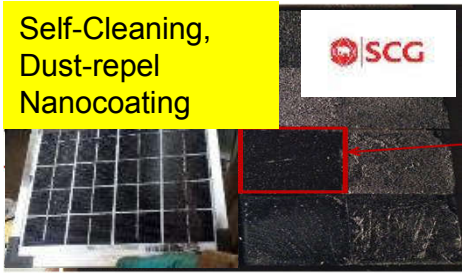
Functionalized nanomaterials

Self-Assembled Hydrophobic SiO2 Nanolayer

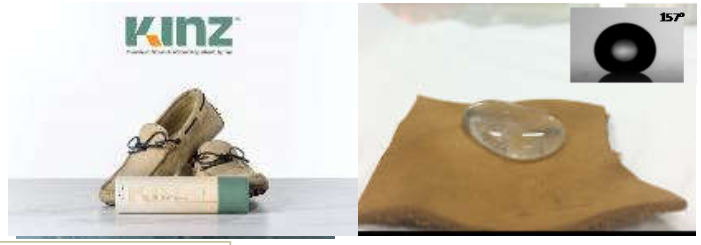


Self-cleaning surface & Hybrid Solar Cell Coating

Self-Cleaning, Dust-repel Nanocoating



Development of functionalized nanomaterials and improve coating technique to achieve desired properties and functions making an impact of 160 MB with 30 MB investment for energy industry (ATE Co. 2017).



Thai Patent Application

Material Platform: As-designed and functional organic and inorganic nanoparticles and nanorods
(SiO2, Au, Ag, fluorocarbon, etc)
Fabrication Platform: Self-assembly, surface-induced orientation, convective deposition, CVD, PVD, chemical reductions, nanocoating.

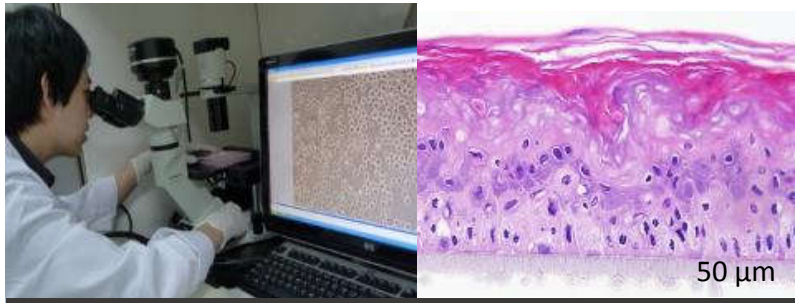
Int.Partner : Professor David Lewis, Director Flinders Nanotechnology, School of Chemical & Physical Sciences, Flinders University, AUSTRALIA (Solar Cell)

Nanometrology and Characterizations and Engineering Unit

Research and development in the field of nano-metrology, nano-safety, nanoscale testing service, including nano-characterization of nano product properties, and engineering-prototype development. We also provide the research and development projects available to industrial sectors by using modern and advanced nanotechnology instruments. Our high quality services are also certified with both national and international standards.

- Nano Characterizations (NCL)
- Nano Safety and Risk Assessment (SRA)
- Monitoring and Process Engineering (MAP)

Research Highlights



in vitro models for determining toxicological effects

Electronic-sensory system

Facilities for nanoscale physico-chemical characterization

NANOTEC Characterization Facility: National Advanced Nano-characterization Center (NANC)

Nanostructure and Mechanical Characterization

Nano Stability Analysis

Nanoscale Identification and Analysis

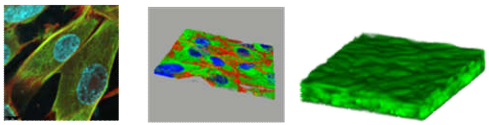
Chemical Identification

Nano-biomolecular Analysis

In vivo Nanotoxicology Analysis

Integrative Microbiology and Nanosafety Analysis

Cell Culture and Tissue Engineering & Nanomaterial Exposure and Monitoring



3D Organotypic Models

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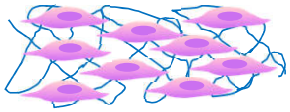
Core Technology: Tissue engineering

Principle and Differentiation:

Cells are generally grown in culture media as 2D monolayer over a long period of incubation. The cells need a supporting matrix or scaffold to form 3D-structure.

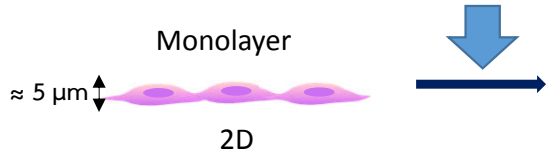
Fibroblasts in polyglactin mesh


In porous/fibrous matrix


In hydrogel gel matrix

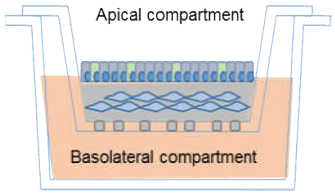
3D tissue can be developed without scaffold

- Treatment with specific reagents
- Adjustment of cell culture conditions
- Using optimal systems



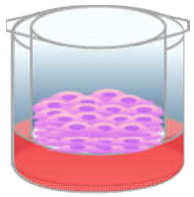
Potential applications: Toxicological testing of raw materials and products

- **3D intestinal model**

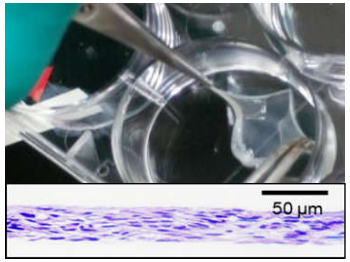


- Permeability
- Nano-bio interaction
- Toxicological testing
- Genotoxicity
- Cellular uptake
- Effect on tight junction

- **3D skin model**



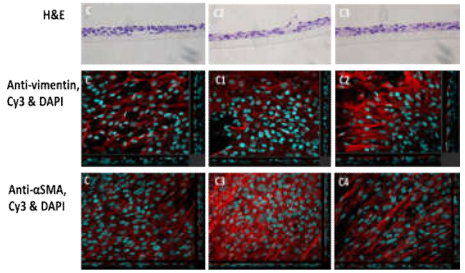
- Skin irritation/corrosion
- Skin permeation
- Phototoxicity
- Toxicological testing
- Genotoxicity

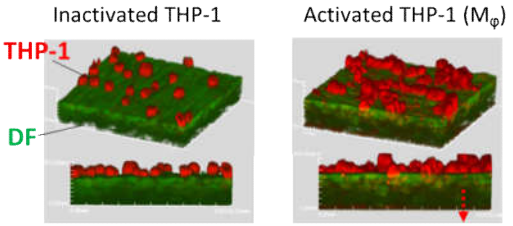


Collagen-rich 3D fibroblast tissue without exogenous materials can be constructed

Key results/achievement:

Using as alternative models to animal testing, in harmonized with international acceptance practices (3Rs principle).





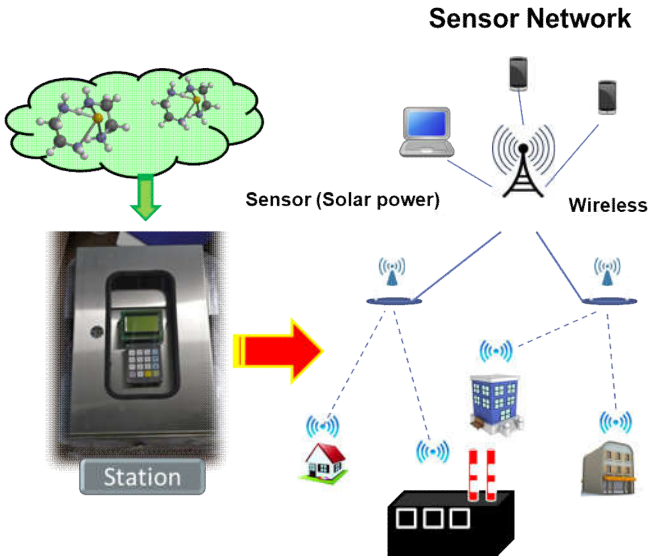
E-sensory for quality evaluation

Research and development aims to design and develop the physical and chemical sensing devices include artificial intelligence (AI) for identification and quality evaluation in several industrial requirement and their problem solving. The potential for developing on device AI include high performance devices and enhanced reliability, such as the specific electronic nose and electronic sensory that can identify specific characteristics of the targets more than conventional detectors.

Research Highlights

E-Nose

Air monitoring station



E-Senss for Thai food

E-sensory for bakery

NANOTEC in 2017

High Economic or Societal Impacts

Flagship


Energy


Food


Textile


Health


Environment

Product Champions

Potential Products

NANOTEC Platform Technology

Nanomaterials : Design & Synthesis	Nanoscale Characterization : Metrology, Safety & Standards	Nano Systems : Engineering & Advanced Manufacturing

รูปแบบของการดำเนินการโครงการ Flagship ระยะที่ 2

Flagship	*Product Champion	**Potential Products	Platform Technology
1 Future Energy	• Nano Catalyst for Energy	• Super Capacitor • Energy Storage	Nanomaterials : Design & Synthesis
2 Functional Textile	• n-Breeze (Nano Fibrous Filter for TB Prevention)	• Nano-Fiber and Porous Membrane	Nanoscale Characterization : Metrology, Safety & Standards
3 Smart Health	• INSpectDx (Portable Colposcope : Cancer) • ชุดตรวจเบาหวาน	• Nano-Sensor for Cancer/TB Detection • Mosquito Control	
4 Food Innovation (Functional Ingredient)	• B-Fresh (Anti-Microbial Sachet)	• Healthy Food	Nano Systems : Engineering & Advanced Manufacturing
5 Clean Environment	• Water Filtration	• Dust Detector • Sorbent for Hg	

*Product Champion : ผลงานวิจัยที่มีศักยภาพในการพัฒนาต่อยอดเพื่อนำไปใช้ในการสร้างประโยชน์ในภาคเศรษฐกิจและสังคมได้อย่างเป็นรูปธรรม ซึ่ง ศน. ใช้กลไกการสนับสนุนและผลักดันในรูปแบบของโครงการ Flagship Project

**Potential Products: แผนงานวิจัยที่มีศักยภาพซึ่งพร้อมจะต่อยอดการดำเนินการในลักษณะโครงการวิจัยขนาดใหญ่ ซึ่ง ศน. ใช้กลไกการสนับสนุนและผลักดันในรูปแบบของโครงการ Research Project Based

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ขอบข่ายหรือหัวข้อวิจัยสำหรับศูนย์เครือข่ายการวิจัยและพัฒนาด้านนาโนเทคโนโลยี ที่มุ่งเน้น

1. Nanomedicine
2. Nanotechnology for Energy
3. Nanotechnology for Food & Agriculture
4. Nanotechnology for Environment
5. Nanotechnology for Functional textiles & Fibers
6. Nanotechnology for Cosmeceutical Products /Thai Herbs
7. Nanotechnology for Metrology and Standardization

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanomedicine

ตาม Nanotechnology Technology Roadmap

1

RDA1 Prevention, diagnosis and treatment of important diseases

	2560	2561	2562	2563	2564
R&D Area	**RDA 1.1 Nanosensors for diagnosis and screening**				
GOAL	**Important diagnostic kits that are ready for production and meet the standards**				
Key Achievement	KA 1.1.1 Early diagnosis Nanosensors for emerging and re-emerging infectious diseases e.g. MERS, Flu, **tuberculosis**				
	KA 1.1.2 Diagnostics Nanosensors for cancer				
	KA 1.1.3 Diagnostics Nanosensors especially for elderly population e.g. **diabetes,** Cardiovascular, Neurodegenerative disease, Alzheimer's disease				
	KA 1.1.4 High precision Nano imaging systems				
	ชุดตรวจมะเร็งปากมดลูก หรือ noncoding RNA ในเลือด (liquid biopsy) ชุดตรวจวัณโรคแฝง แบบใช้เทคนิค microneedle (แผ่นแปะ)				
Key Technology	Optical, Electrical, Electrochemical, Magnetic and piezoelectric detections and integrated systems				
	High-throughput screening & Microfluidic and Multiplexing analysis technology				
	Nanomaterial-based signal enhancement/target enrichment process				
	Hierarchical Nanomaterial synthesis, assembly, and surface functionalization				
	Biomarker/ targeting ligands screening e.g. antibody, aptamer, peptides				

เน้นด้าน clinical test

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Energy

ตาม Nanotechnology Technology Roadmap

2

RDA5 Nanotechnology for Future Energy

	2560	2561	2562	2563	2564
R&D Area	**RDA 5.1 Nanomaterials for Energy Production and Utilizatio**				
GOAL	**Nanomaterials and Nanocatalysts for Commercial Renewable Energy and Biorefineries**				
Key Achievement	**KA 5.1.1 Nanocatalysts and membrane for Biorefineries and Biofuels**				
	KA 5.1.2 Nanocatalysts for high performance diesel and petrochemicals				
	KA 5.1.3 Nanocatalysts for CO_2 conversion and artificial photosynthesis				
Key Technology	Catalyst design, synthesis and fabrication				
	Integrated engineering system of nanocatalysts and nanomaterials				
	Molecular simulation / Process simulation				
	Catalyst performance evaluation/ Pre-Pilot prototyping and manufacturing				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Energy
ตาม Nanotechnology Technology Roadmap

2

RDA5 Nanotechnology for Future Energy

	2560	2561	2562	2563	2564
R&D Area	**RDA 5.2 Nanotechnology for Energy Storage and Saving**				
GOAL	**Nanomaterials and nanotechnology for efficient energy harvesting, energy storage and energy saving**				
Key Achievement	**KA 5.2.1 Fourth generation cells and photovoltaic materials**				
	KA 5.2.2 Energy harvesting devices and systems				
	KA 5.2.3 High-capacity Battery and **Super capacitor**				
	KA 5.2.4 Energy Efficiency Light Source				
Key Technology	High performance electrodes/photoelectrodes				
	Nanoporous materials				
	Fabrication processes				
	Catalyst design, synthesis and manufacturing				
	Pre-Pilot Prototyping				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Food & Agriculture ตาม Nanotechnology Technology Roadmap

RDA4 Postharvest technology and food packaging

2560 2561 2562 2563 2564

R&D Area

RDA 4.1 Nanomaterials for food packaging and preservation (Smart packaging)

GOAL

Functional packaging for food and agricultural industry

Key Achievement

- KA 4.1.1 Functional packaging for food and agricultural products
- KA 4.1.2 Active packaging for extended product shelf life
- **KA 4.1.3 Intelligent packaging for indicating food quality**

Food Processing / Food Science

Key Technology

- Controlled-release active components
- Absorbent and separation technology
- Sensor and sensor arrays: material and device fabrication/assembly
- Bio-degradable/bio-compatible nanomaterials
- Printing/coating and packaging technology

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Food & Agriculture ตาม Nanotechnology Technology Roadmap

RDA4 Postharvest technology and food packaging

	2560	2561	2562	2563	2564
R&D Area	**RDA 4.2 Nanosensors for agricultural products**				
GOAL	**Sensing device for detection of chemical residue, food quality and agricultural product**				
Key Achievement	KA 4.2.1 Microbial detection KA 4.2.2 Chemical toxic residue sensor and system KA 4.2.3 Heavy metal ion sensor and system **KA 4.2.4 Sensor array for product quality control**				
Key Technology	Optical, Electrical and electrochemical detections and integrated system Microfluidic technology Lateral flow assay technology Target enrichment/signal amplification by nanotechnology Nanostructure fabrication and surface modification				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Environment ตาม Nanotechnology Technology Roadmap

RDA6 Nanotechnology for Clean Environment

	2560	2561	2562	2563	2564
R&D Area	**RDA 6.1 Nanotechnology for air monitoring and treatment**				
GOAL	**Development of the efficient air monitoring devices/ sorbents and filters for hazardous gas, volatile organic compounds, and air borne**				
Key Achievement	KA 6.1.1 Highly selective and sensitive gas sensors (ppb)				
	KA 6.1.2 **Super sorbents**, membrane and catalysts				
	KA 6.1.3 Anti-virus and anti-bacterial air filters				
	Photocatalysis / Membrane / Sorbent / Process Implement				
Key Technology	Organic-Inorganic composite / Bio-mimetic nanomaterials				
	Nanofiltration / Phyto-remediation / Advance oxidation				
	Nanomaterial and Process design for lower energy consumption and improved separation efficiency				
	Optical, chemical, electrochemical detections				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Environment ตาม Nanotechnology Technology Roadmap

RDA6 Nanotechnology for Clean Environment

	2560	2561	2562	2563	2564
R&D Area	**RDA 6.2 Nanotechnology for clean water**				
GOAL	**Development of water purification systems and monitoring devices**				
Key Achievement	**KA 6.2.1 Nanotechnology and nanomembrane for desalination**				
	KA 6.2.2 Drinking-water filter kits				
	KA 6.2.3 Heavy metal sensors				
	Photocatalysis / Membrane / Sorbent / Process Implement				
Key Technology	Adsorption and advance oxidation				
	Synthesis and fabrication of nanomaterials				
	Optical, chemical, electrochemical detections				
	Surface modification & patterning/Ion-exchange materials				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Nanotechnology for Functional textiles & Fibers ตาม Nanotechnology Technology Roadmap

RDA8 Exploring cross-platform and key emerging technologies

	2560	2561	2562	2563	2564
R&D Area	**RDA 8.2 Nano functional textiles & Fibers for advanced applications**				
GOAL	Specialty textiles with value-added nanofunctions for industrial applications.				
Key Achievement	KA 8.2.1 Thermally or optically or electrically active fibers				
	KA 8.2.2 Multifunctional high strength fibers				
	KA 8.2.3 Degradable & ecofriendly fibers				
Key Technology	Chemical modifications, New material discoveries, synthesis, nanodispersion, blends&composites, nano&micro encapsulations				
	Advanced functional printing, Coating, or spinning				
	Hierarchical (Multi-length scale/Multicomponent) fiber technology				
	Carbon Nanomaterials for reinforcement technology				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงานในด้าน Nanotechnology for Cosmeceutical Products/Thai Herbs

RDA2 Utilization of natural products and biodiversity

6

R&D Area

RDA 2.1 Nanocosmeceuticals and encapsulated Thai herbal and natural products

GOAL

Cosmetic and Nano cosmeceutical products from herbal and natural ingredients

Key Achievement

- KA 2.1.1 Multifunction cosmeceutical products : skin care, facial, body, hair
- KA 2.1.2 Long lasting properties products
- KA 2.1.3 Advanced transdermal patches and devices
- KA 2.1.4 Rejuvenation products
- KA 2.1.5 3D skin model for cosmetic testing
- KA 2.1.6 Increased physical properties, efficacy, standardization of products

1.ผลิตภัณฑ์ดูแลผิวพรรณและเครื่องสำอาง
2. ผลิตภัณฑ์ดูแลสุขภาพสัตว์

-การสกัด, ทำให้บริสุทธิ์, และวิเคราะห์โครงสร้างสารออกฤทธิ์จากสมุนไพร
-การพัฒนา biological assays สำหรับทดสอบฤทธิ์และกลไกการออกฤทธิ์
-การค้นหาสารออกฤทธิ์ที่มีคุณสมบัติที่ต้องการ แบบ high-throughput screening
-การศึกษาคุณสมบัติของสารออกฤทธิ์ในสัตว์ทดลอง

Key Technology

- Microneedle technology
- Electrospinning
- New biomaterial synthesis, biocompatible and biodegradable surfactant
- Scalable – formulation/pilot production technology
- Encapsulation and controlled release technology
- Extraction and purification technology

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Metrology and Standardization ตาม Nanotechnology Technology Roadmap

RDA7 Physical and regulatory infrastructure

	2560	2561	2562	2563	2564
R&D Area	**RDA 7.1 Nanosafety and risk assessment**				
GOAL	**Systems for nanomaterial contamination screening and risk assessment of nanomaterials in the environment according to standard procedures**				
Key Achievement	**KA 7.1.1 Complete platform on risk assessment** • Nanomaterials-biological system interactions / toxicological testing (OECD GLP) • Nanomaterials release-fate-transport-exposure (environmental simulation, microorganisms and Zebrafish models etc.)				
	KA 7.1.2 Exposure assessment (Human resource, workplace and the environment) • Monitoring methods for nanomaterials (solid dust/ liquid aerosol) in the workplace/ instrumentation design and prototyping • Modeling of exposure routes (dermal/ lung/ oral)				
Key Technology	Toxicological testing and modeling of exposure routes				
	Super-resolution molecular imaging				
	Nanoparticle monitoring and characterization				
	Cell and tissue engineering				

ตัวอย่าง หัวข้อวิจัยที่ ศน. สนใจเพื่อร่วมงาน ในด้าน Metrology and Standardization ตาม Nanotechnology Technology Roadmap

RDA7 Physical and regulatory infrastructure

	2560	2561	2562	2563	2564
R&D Area	**RDA 7.2 Nanoscale characterization, precision analys and standards**				
GOAL	**Method development and equipment installation for Nanocharacterization**				
Key Achievement	KA 7.2.1 Development to improve high resolution analysis method for Manufactured nanomaterials (Structure, Morphology and composition)				
	KA 7.2.2 Standard protocols for novel properties and functions of nano-enabled products (ISO/IEC 17025)				
		KA 7.2.3 Traceable metrological methods for nanoscale materials			
Key Technology	Physico-chemical characterization for Manufactured nanomaterials (ISO/IEC 17025)				
	Compositional and elemental analysis method (Esp.Quantitative)				
	Metrological methods and reference (Dimension, Force, Chemical, etc.)				
	Surface analysis & probe interaction with SPM & EM				

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