May 2, 2017

NANOTEC
a member of NSTDA

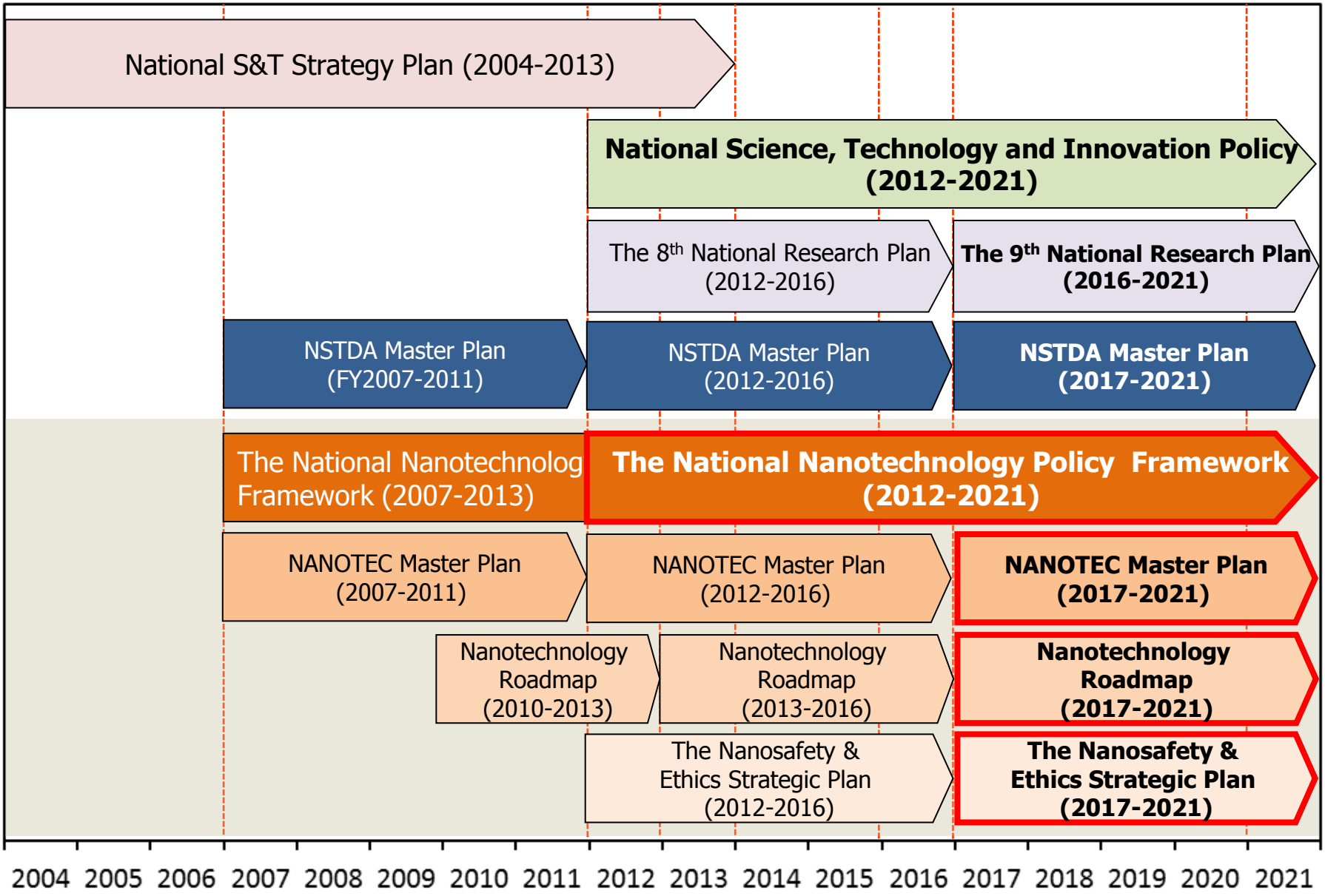
Policy frameworks for nanotechnology to address health and safety concerns – Risk assessment and safety compliance

Rawiwan Maniratanachote, *Ph.D.*
rawiwan@nanotec.or.th

National Nanotechnology Center (NANOTEC)
National Science and Technology Development Agency (NSTDA)
THAILAND

International Conference on Nanotechnology for Safe and Sustainable Development
&
Consultative Meeting on Proposed ASEAN Nanosafety Networking Platform
2-4 May 2017
Putrajaya, MALAYSIA

Thailand's Major S&T Plan



Thailand National Nanotechnology Policy Framework (2012-2021)

- National Science Technology and Innovation Policy Office (STI) and NANOTEC jointly collaborated to formulate the (2nd) National Nanotechnology Policy Framework in 2010
- This is to set guidelines and directions for Thailand's nanotechnology development for the next 10 years
- The process involved experts from all sectors, in correspondence with needs, strengths, opportunities, potentiality, competency, challenges, and internal and external fundamental factors for the development of Thailand's nanotechnology.
- On Sep. 11, 2012, the **Royal Thai Government approved the National Nanotechnology Policy Framework (2012-2021),** and relevant agencies were afterwards entrusted with the implementation of the Policy Framework
- STI and NANOTEC serve as Joint Secretariat for the National Policy

Thailand National Nanotechnology Policy Framework (2012-2021)

Major goals

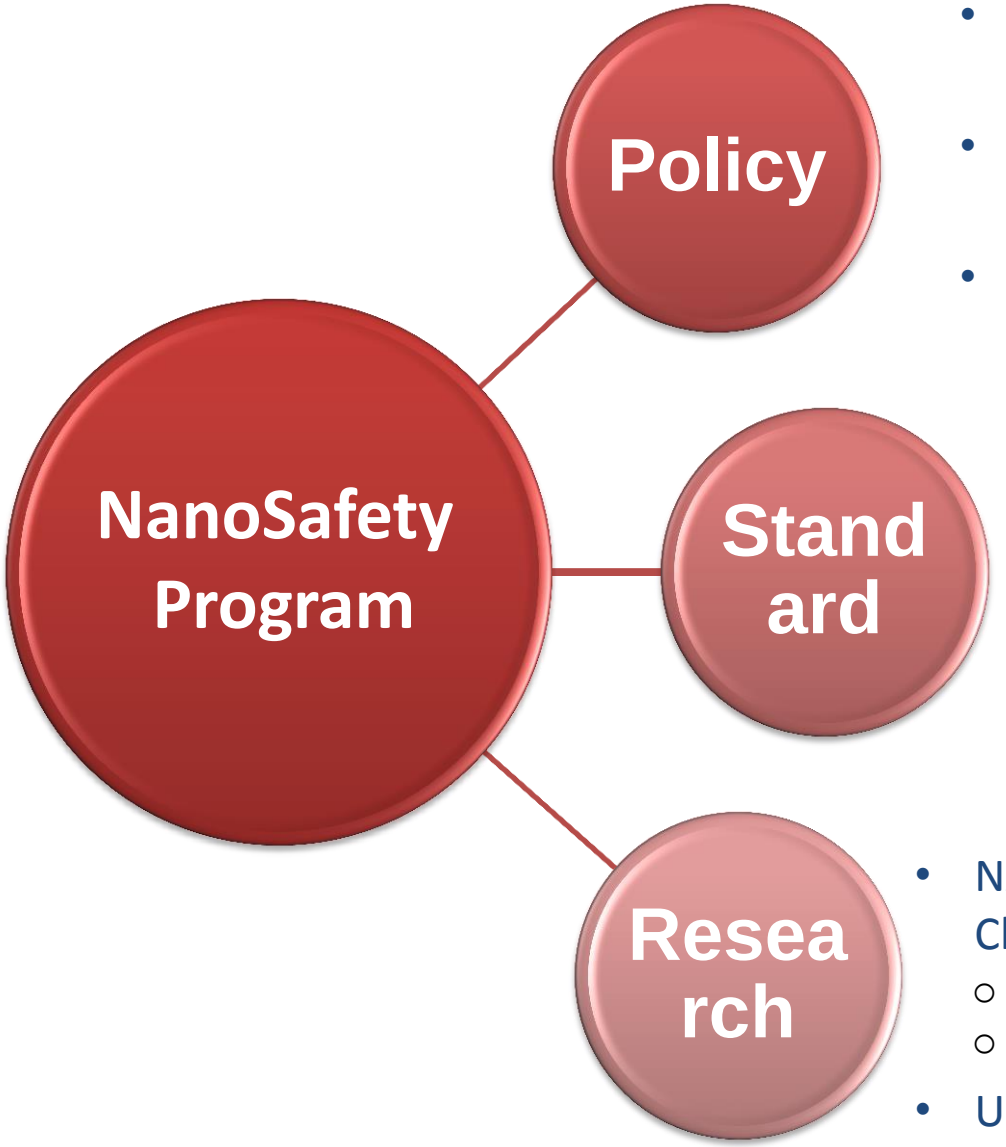
- Improving quality of life, well-being and public health by the development of materials, products and devices through nanotechnology
- Enhancing capability of agricultural sector and manufacturing industry to meet the market demands through nanotechnology
- Becoming ASEAN's leader in nanotechnology research and education

Nanotechnology Roadmap 2017-2021 (Thailand)

	R&D Agenda	Focus Theme
Health & Medicine	**RDA1** Prevention, diagnosis and treatment of important diseases	RDA 1.1 Nanosensors for diagnosis and screening
		RDA 1.2 Nanomedicine and medical materials
Agriculture & Industry	**RDA2** Utilization of natural products and biodiversity	RDA 2.1 Nanocosmeceuticals and encapsulated Thai herbal and natural products
		RDA 2.2 Nanotechnology for animal health and feeds
	RDA3 Improvement of agricultural process and control of insects and pests	RDA 3.1 Nanotechnology for pre-harvesting
	RDA4 Post-harvest technology and food packaging	RDA 4.1 Nanomaterials for food packaging and preservation (Smart packaging)
		RDA 4.2 Nanosensors for agricultural products
Energy & Environment	**RDA5** Nanotechnology for Future Energy	RDA 5.1 Nanomaterials for Energy Production& Utilization
		RDA 5.2 Nanotechnology for Energy Storage &Saving
	RDA6 Nanotechnology for Clean Environment	RDA 6.1 Nanomaterials for air monitoring& treatment
		RDA 6.2 Nanotechnology for clean water
Physical Infrastructure	**RDA7** Physical and regulatory infrastructure	RDA 7.1 Nanosafety and risk assessment
		RDA 7.2 Nanoscale characterization, precision analysis and standards
	RDA8 Exploring cross-platform and key emerging technologies	RDA 8.1 NanoElectronics
		RDA 8.2 Nano functional textiles & Fibers for advanced applications
		RDA 8.3 Nanotechnology for military defense
		RDA 8.4 Nano materials and methodology for future applications
Platform Technology	Nanomaterials Design and Synthesis	Nano Systems, Engineering and Advanced Manufacturing
		Nano Metrology & Characterization and Standards

Thailand's Status on NanoSafety

Thailand's Status on Nanosafety



- National NanoSafety and Ethics Strategic Plan Framework
- Industrial standardization manuals related to nanotechnology (TISI)
- Guidance for Industry on Nano Health Products (MOPH)

- Inter-laboratory Comparison
- NanoQ

- NANOTEC (Nanometrology and Characterizations and Engineering Unit)
  - Nano Safety and Risk Assessment Laboratory
  - Nano-characterization Laboratory
- Universities

POLICY

Nanosafety and Ethics Strategic Plan (2012-2016)

Vision

Safe-nano for Thailand's Sustainable Development

Objective

To enhance health and environment safety as well as promote social security via **ethical**, **sustainable and proper engagement in R&D**, **production**, distribution and nanotechnology and nanoproduct usage

3 Key Performance Indicators

Knowledge management	Product Labeling	Public awareness
		

3 Strategies

Establish the knowledge management center to manage the information of nanosafety and ethics and nanoproducts	Develop and reinforce measures as well as mechanisms of monitoring and enforcement	Promote public engagement

5 Measures

Engineering | **Enforcement** | **Economics** | **Education** | **Empowerment**

Nanosafety and Ethics Strategic Plan (2017-2021)

NANOTEC
a member of NSTDA

NANOTEC
NEWS

Final meeting of the Working Group of Nanosafety and Ethics Strategic Plan 2017-2021

24/02/2017 admin ข่าวประชาสัมพันธ์, ประชาสัมพันธ์

Prof. Sirirurg Songsivilai, Secretary-General of the National Research Council of Thailand (NRCT) and Chairman of the Working Group to draft the Nanosafety and Ethics Strategic Plan 2017-2021 presided at the final working group meeting this morning at National Science Technology and Innovation Policy Office (STI). The discussion of the meeting focused on the comments made by the participants who attended the Public Hearing session which was conducted on December 22, 2016.

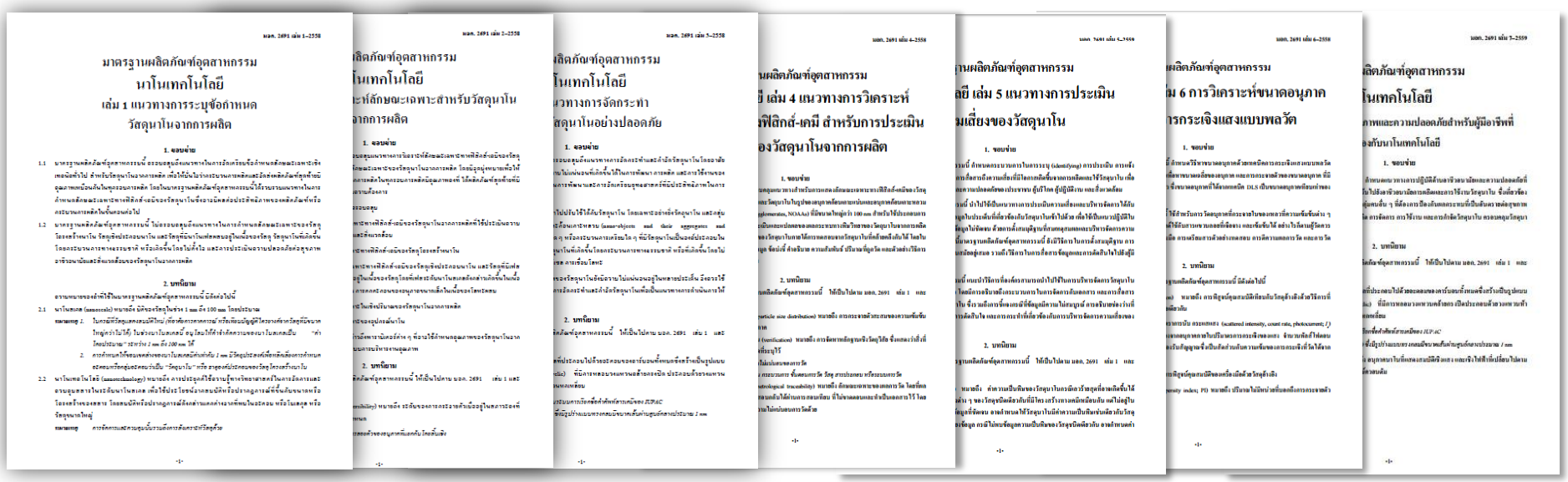
Prof. Sirirurg expect the final approval by the government should be in May/June 2017.

Seven industrial standardization manuals related to nanotechnology (2016)

มาตรฐานอุตสาหกรรมด้านนาโนเทคโนโลยีร่วมกับ สมอ. ประกาศในราชกิจจานุเบกษาแล้ว 7 ฉบับ

Part 1: Guidance on specifying manufactured nanomaterials
Part 2: Guidance on material characterization for specifying manufactured nanomaterials
Part 3: Guidance on safe handling and disposal of nanomaterials
Part 4: Guidance on physio-chemical characterization for toxicologic assessment of manufactrured nanomaterials
Part 5: Guidance on nanomaterial risk evaluation
Part 6: Particle size analysis using dynamic light scattering
Part 7: Health and safety practices in occupational setting relevant to nanomaterials

Collaboration between "**Thai Industrial Standards Institute (TISI)** and **NANOTEC**"



Guidance for Industry on Nano Health Products

NANOTEC
a member of NSTDA

FDA Thailand, Ministry of Public Health

สำนักงานคณะกรรมการอาหารและยา กระทรวงสาธารณสุข

2016

จัดทำโดย : คณะทำงานพัฒนาและกำหนดแนวทางการกำกับดูแลประสิทธิภาพและความปลอดภัยของผลิตภัณฑ์สุขภาพนาโน

The guidance document contains 4 chapters:

Chapter 1 Application of nanomaterials and nanotechnology in health products

Chapter 2 Safety of nanomaterials and nano health products

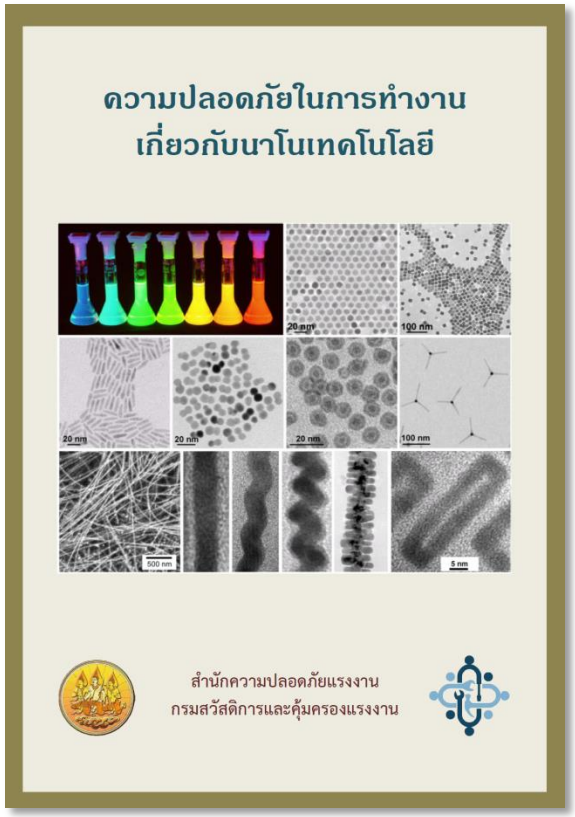
Chapter 3 International regulation of nano health products

Chapter 4 Guidance on registration of nano health products in Thailand

Guidance on Safe Handling of Nanotechnology

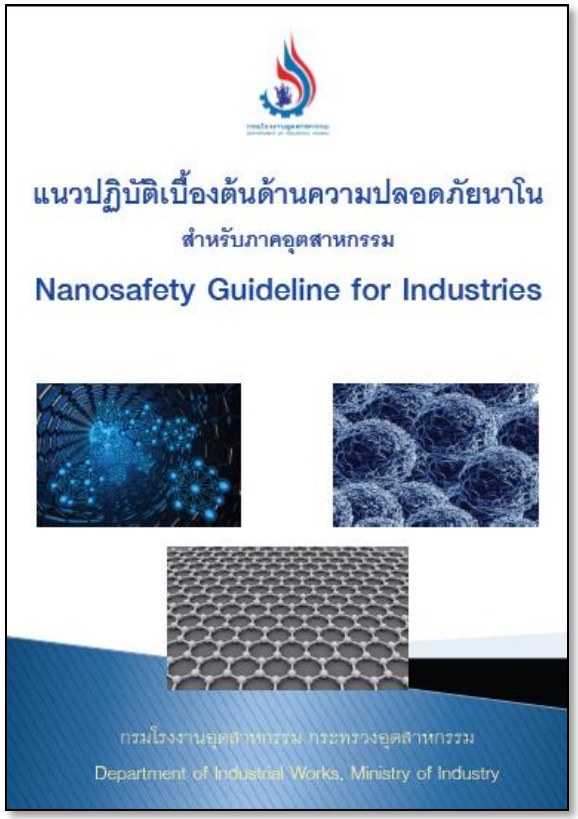
NANOTEC
a member of NSTDA

2011



Occupational Safety and Health Bureau, Department of Labour Protection and Welfare, Ministry of Labour, Thailand

2012



Department of Industrial Works, Ministry of Industry, Thailand

STANDARD

NANOTEC
a member of NSTDA

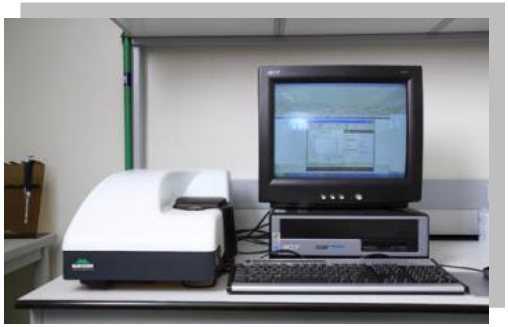
Nanoparticle Characterization - Supplementary Comparison on Nanoparticle's Size

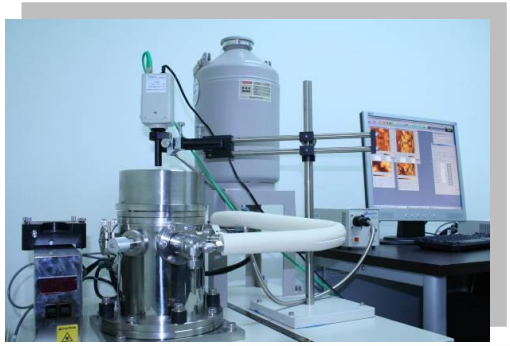
CERTIFIED REFERENCE MATERIALS:

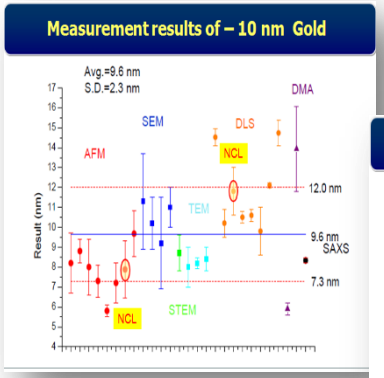
GOLD NANOPARTICLES
SILVER NANOPARTICLES
POLYSTYRENE NANOPARTICLES

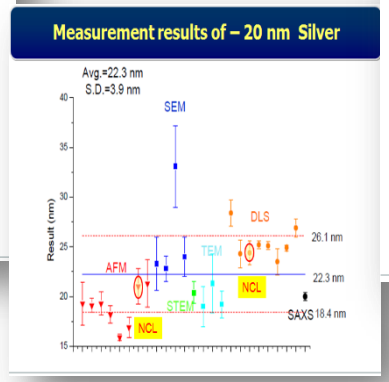
NANOTEC
a member of NSTDA

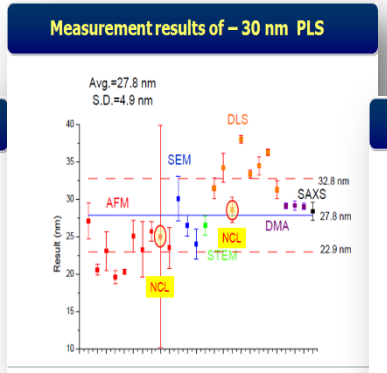
NIMT

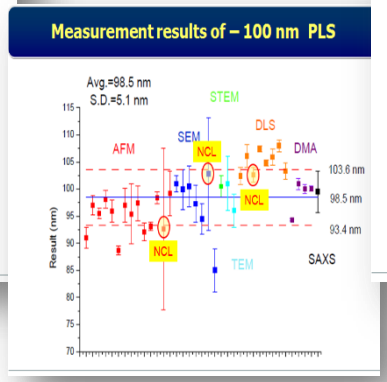


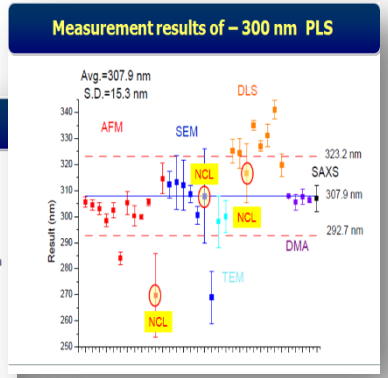












Inter-Lab Comparison – MTS Cytotoxicity Assay

NANOTEC a member of NSTDA

Round Robin Project

NIST National Institute of Standards and Technology U.S. Department of Commerce

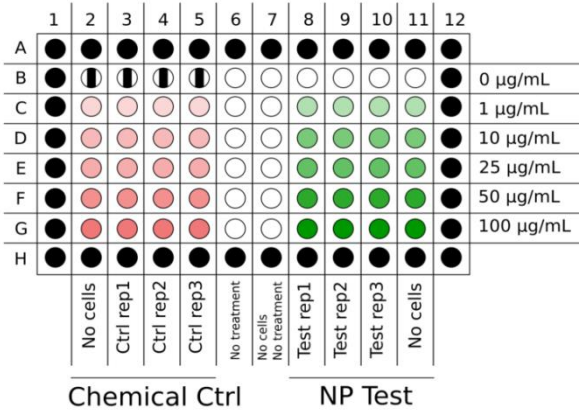
JRC EUROPEAN COMMISSION

EMPA Materials Science & Technology

KRISS

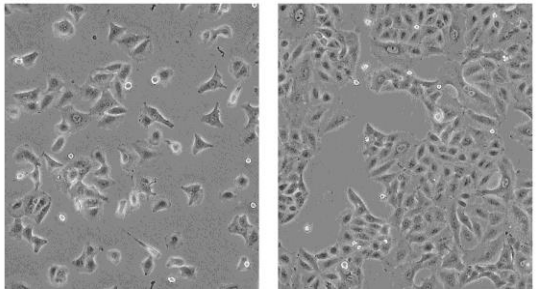
NANOTEC a member of NSTDA

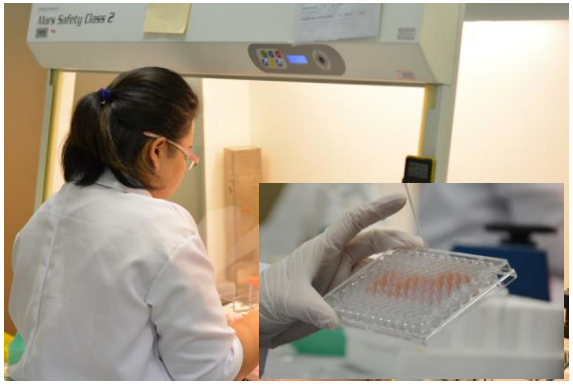
SOP: MTS cell viability assay

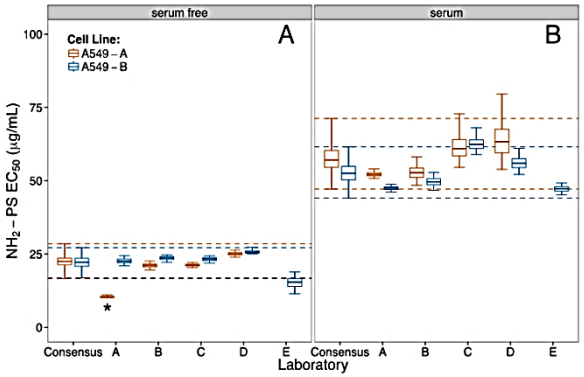


Materials:

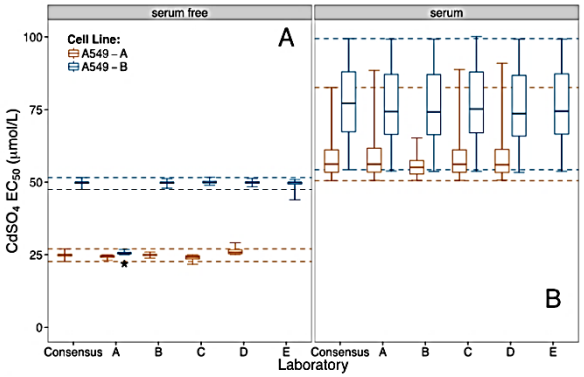
- Polystyrene nanoparticles
- Positive control ($CdSO_4$)
- Reagents
- A549 cells







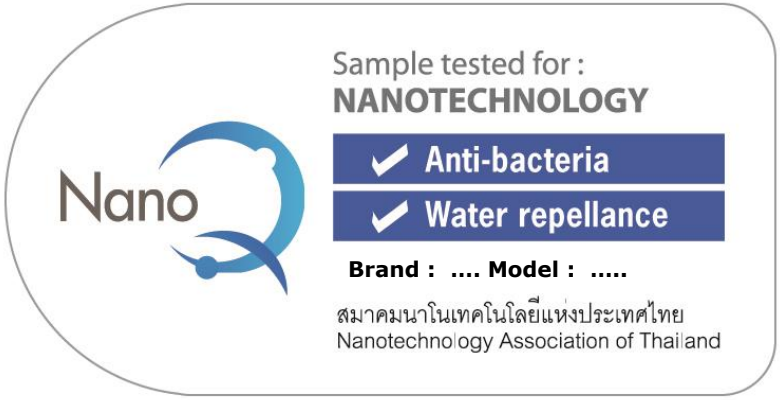
Interlaboratory comparison of positive charged ***polystyrene NP*** *(PSR-NH_2) with MTS assay*



Interlaboratory comparison of the chemical reaction control ***$CdSO_4$***

Reference: J. Elliott *et. al.*, Toward Achieving Harmonization in a Nano-cytotoxicity Assay Measurement by an interlaboratory comparisons study, *ALTEX, 2017*.

Nano Labeling (NanoQ)



NanoQ is a certified mark for nanoproducts (**Functional Textiles, Coating Materials, Household Products**) which are certified by Nanotechnology Association of Thailand.

Motivation to have Nano Q

- ☑ **Increase public trust**: Facilitate healthy development of nanotechnology
- ☑ **Protect consumer**: Avoid waste money
- ☑ **Protect good companies**: Eliminate unfair competitions between good and bad products
- ☑ **Facilitate trade**: Stimulate economic growth

RESEARCH

Nanometrology and Characterizations and Engineering Unit

NANOTEC a member of NSTDA

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

- **Nano Safety and Risk Assessment Laboratory (SRA)**
- **Nano-Characterization Laboratory (NCL)**
- **Engineering and Manufacturing (ENM)**

Investigations on toxicity of nanomaterials and nanoproducts on human health and the environment

Equipment for nanoscale physico-chemical characterization

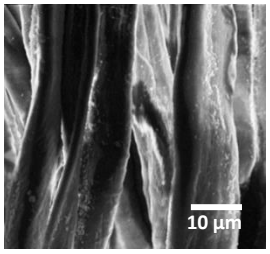
Partnerships & collaboration

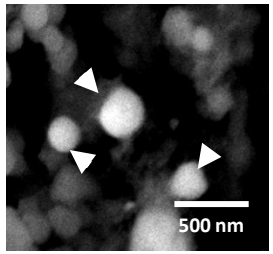
Assessment of Nanoproducts – Safety& efficiency

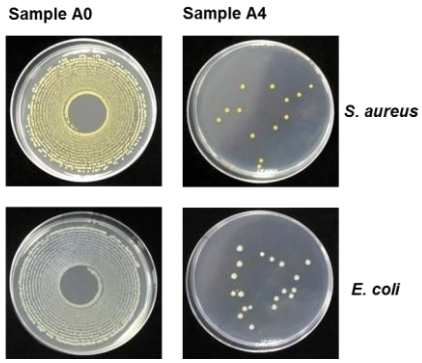
NANOTEC
a member of NSTDA

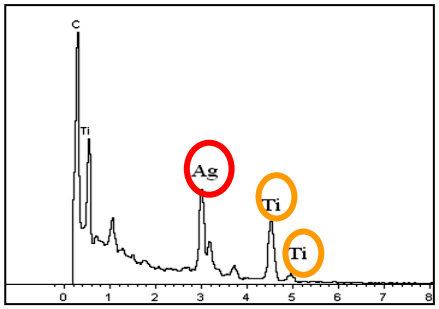
Textiles

Cosmetics and health products









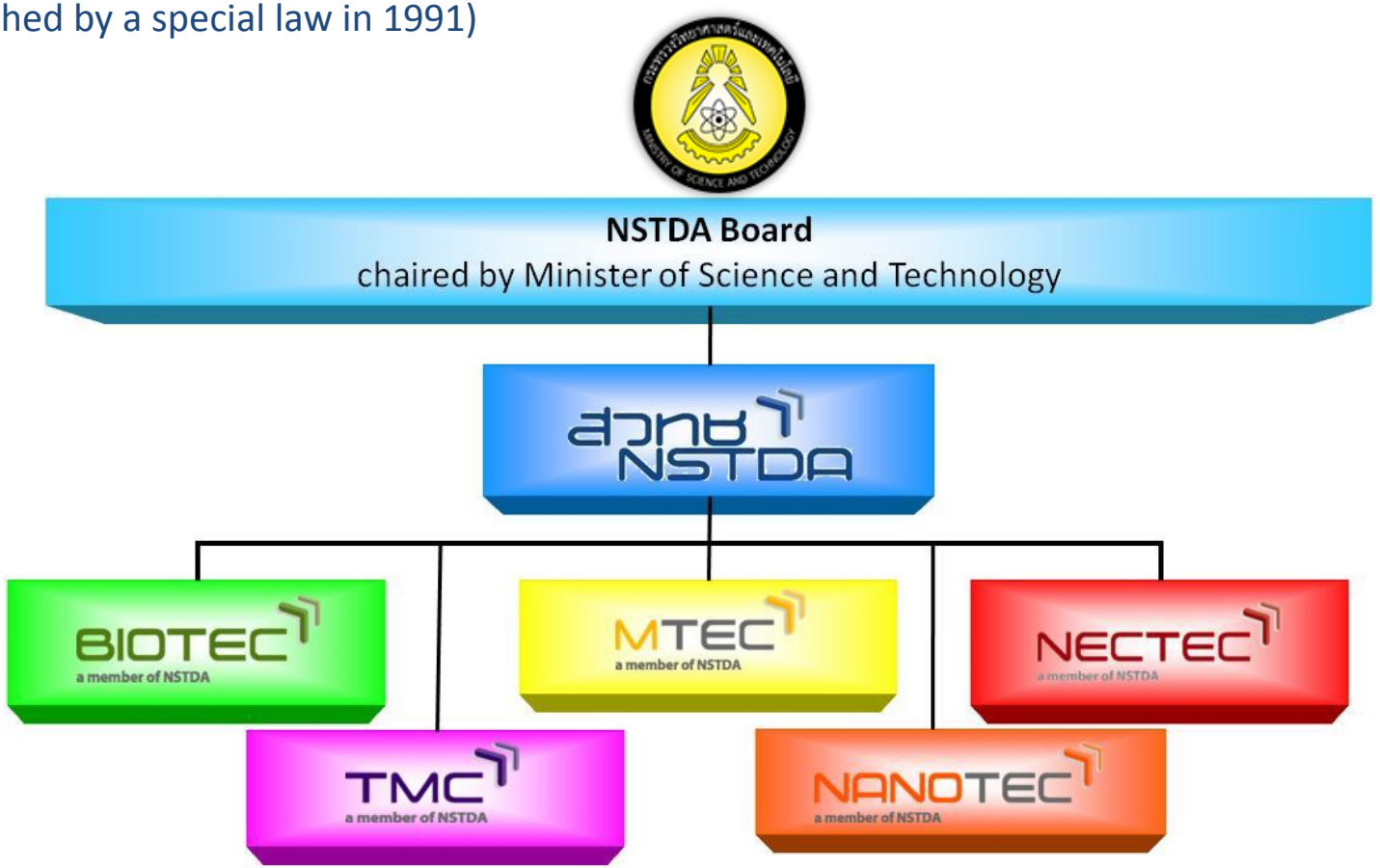
- Characterizations
- Release and sustainability
- Potential exposure
- Biological effects
- Toxicological effects
- Antibacterial efficiency

References:

1) Kulthong et al,. Particle and Fibre Toxicology. 2010, 7: 8.1
2) Wasukan et al., Journal of Nanoparticle Research, 2015, 17:425.

National Science and Technology Development Agency

(Established by a special law in 1991)



BIOTEC : National Center for Genetic Engineering and Biotechnology

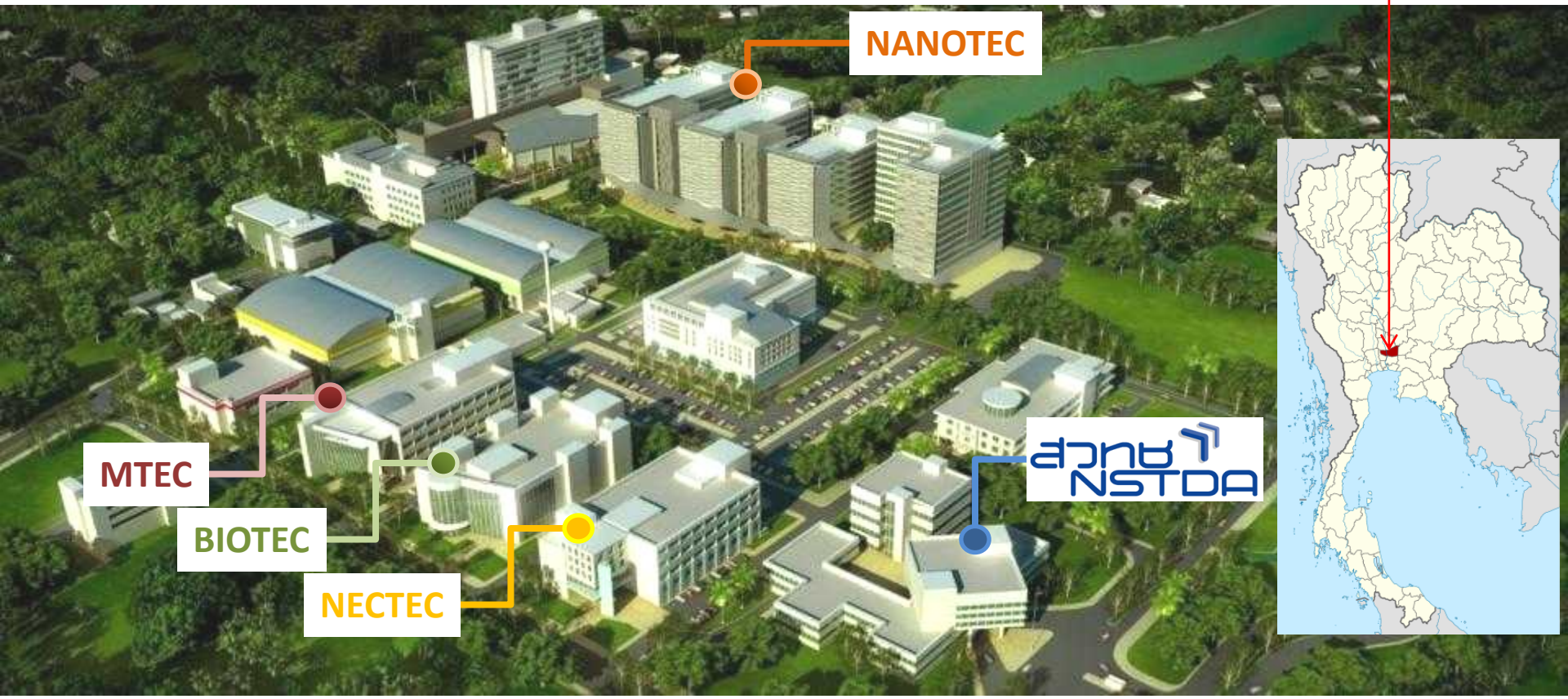
MTEC : National Metal and Materials Technology Center

NECTEC : National Electronics and Computer Technology Center

NANOTEC : National Nanotechnology Center

TMC : Technology Management Center

Thailand Science Park, Pathum Thani



Semi-autonomous, Publicly-funded Research and Technology Organization
Staff ~2,700 (65% in R&D with ~500 PhDs)
Annual operating budget ~USD150m
Work on 4 main technology areas with 4 National centers –- One of which is **Nanotechnology**
105 Research labs: In-house 69 labs / Outside TSP 36 labs
Service and testing laboratories
Also provides Research Grants to universities, etc.

NATIONAL NANOTECHNOLOGY CENTER (NANOTEC)

THE LEADING AGENCY ON NANOTECHNOLOGY DEVELOPMENT IN THAILAND

NANOTEC, established in 13 August 2003, is one of four research agencies operating under the jurisdiction of the National Science and Technology Development Agency (NSTDA) and the Ministry of Science and Technology (MOST).

Dr.Wannee Chinsirikul
Executive Director

www.nanotec.or.th
www.facebook.com/nanotec.thai

National Nanotechnology Center (NANOTEC)

NANOTEC
a member of NSTDA

NANOTEC, is the leading agency on nanotechnology development in Thailand.

Our Vision

NANOTEC for the Benefits of Thailand and Mankind

Our Mission

To conduct and support research, development, design and engineering in nanotechnology, and transfer the technology to industrial sector in order to increase Thailand's competitiveness, and improve the quality of life and the environment.

Our International Quality Standard

In 2012, NANOTEC achieved "3" Certifications

- ISO9001 on the design and execution of R&D operation
- ISO/IEC17025 for competence of testing and calibration laboratories
- TIS18000: Thai Industrial Standard for Occupational Health and Safety Management System

NANOTEC 5 Strategic Research Units

NANOTEC
a member of NSTDA

Work on nanotechnology for life and health.

R&D on innovative medical diagnostics using targeting new molecules, drug delivery and cosmeceuticals from Thai natural resources with major goals to enhance human and animal health.

Work on specific nanomaterials and advanced nanotechnology

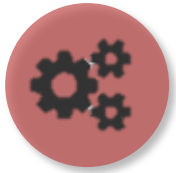
R&D on molecular engineering of responsive materials and aspect expands across nanostructure & functional assembly for innovative design, synthesis and assembly of functional nanomaterials for applications in (bio) chemical sensing/imaging and optoelectronics.

Work on Agriculture and Environment

R&D on innovative food, agriculture and environment with the application of nano-technology to modify materials, structures and surfaces for strengthening economics and social cooperation, and promote environmental sustainability.

Work on nanometrology and engineering analysis

R&D in the field of nano-metrology, nano-safety, nanoscale testing service, including nano-characterization of nano-product properties, and engineering-prototype development by using modern and advanced nanotechnology instruments with high quality services certified with both national and international standards.

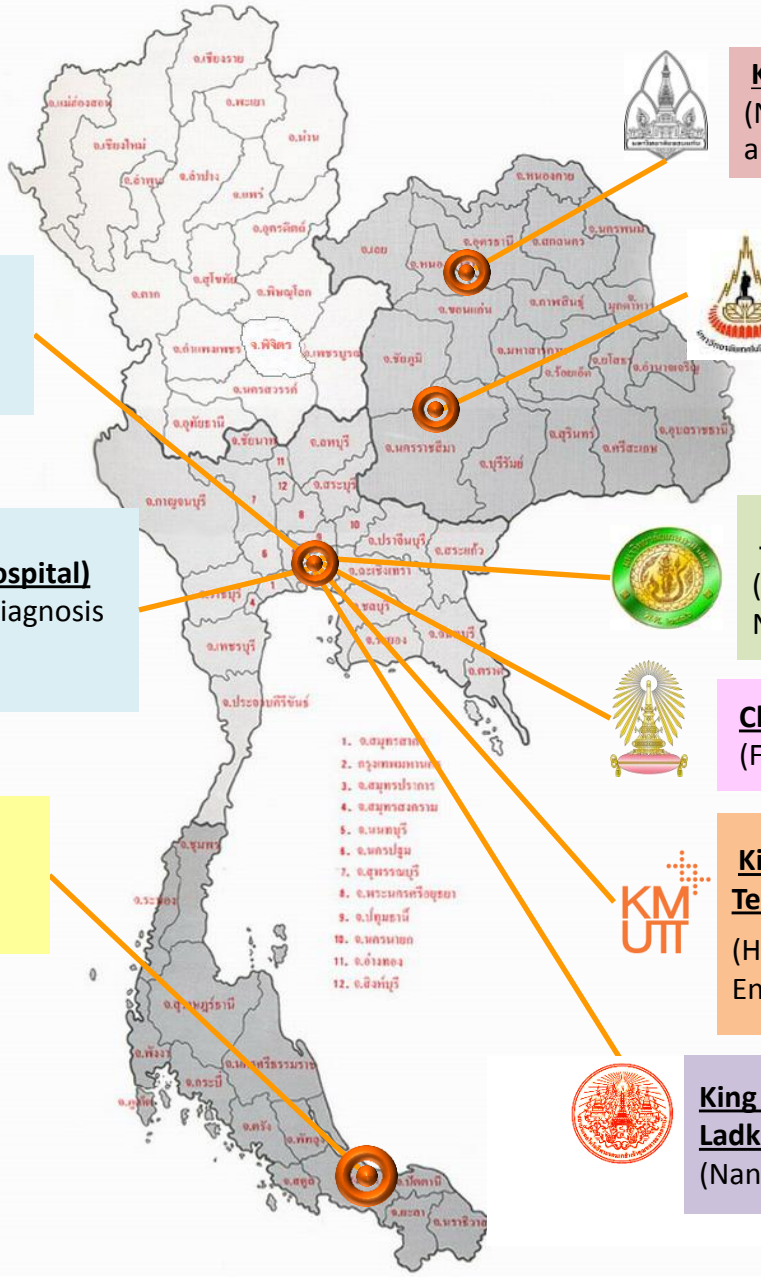


Work on development of nano-materials and nano-system engineering

R&D on synthesis chemistry, fabrication techniques characterization techniques, scaled-up engineering and theoretical calculations to achieve improved design, and utilization of nanomaterials for energy and environment applications.

Center of Excellence (9 Centers from 8 Universities)

NANOTEC
a member of NSTDA



Khon Kaen University
(Nanomaterials for energy production and storage)

Suranaree University of Technology
(Advanced Functional Nanomaterials)

Mahidol University
(Intelligent Materials and Systems)

Kasetsart University
(Nanoscale Materials Design for Green Nanotechnology)

Mahidol University (Siriraj Hospital)
(Nanotechnology for Cancer Diagnosis and treatment)

Chulalongkorn University
(Food and Agriculture)

Prince of Songkla University:
(Drug Delivery System)

King Mongkut's University of Technology Thonburi
(Hybrid Nanomaterials for Alternative Energy)

King Mongkut's Institute of Technology Ladkrabang
(Nanoelectronic Devices)

International Networking Strategies

NANOTEC
a member of NSTDA

Australia:
- Flinders University
- University of Queensland
- University of Technology, Sydney

China:
- Peking University
- The National Center for Nanoscience and Technology (NCNST)

France:
- Organization for Economic Co- operation and Development (OECD)
- ParisTech

Germany:
- Max Planck Institute

Japan:
- National Institute of Advanced Industrial Science and Technology (AIST)
- National Institute for Materials Science (NIMS)
- RIKEN
- National Institutes of Natural Sciences (NINS)
- Kyoto University
- Osaka University
- Kanazawa University

Singapore:
- Institute of Materials Research and Engineering (IMRE), A*STAR
- Temasek Polytechnic

South Korea:
- Konkuk University
- Korea Research Institute of Bioscience and Biotechnology (KRIBB)
- Sungkyunkwan University

Switzerland:
- EMPA
- Ecoles Polytechniques Federal de Lausanne (EPFL)
- United Nations Institute for Training and Research (UNITAR)

United State of America:
- West Virginia University

Vietnam:
- Institute of Materials Science, Vietnam Academy of Science and Technology

NANOTEC
a member of NSTDA

Thank you!

A Driving Force for
National Science and Technology Capability

National Nanotechnology Center
Thailand Science Park
Phahonyothin Road,
Khlong 1, Khlong Luang
Pathum Thani 12120
THAILAND

International Collaboration Section:
Tel. +66(0)2- 564-7100
Fax. +66(0)2- 564-6985
Email: ico@nanotec.or.th
Web: www.nanotec.or.th