ASIA NANO FORUM
ANNUAL REPORT 2019

Autumn 2019

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About Asia Nano Forum

Asia Nano Forum (ANF) is a network organization, founded in May 2004 and became a registered society in Singapore in Oct 2007.

Mission & Objective

The mission of ANF is to promote responsible development of nanotechnology that educationally, socially, environmentally and economically benefits members by fostering the international network collaboration. Its objectives are;

- Foster nanotechnology in the region by creating mechanisms to share information, human and physical resources and expertise
- Support regional economic and environmental development through joint projects addressing major regional issues, with an emphasis on support of developing and emerging economies
- Coordinate mutual access to major infrastructure by member economies
- Promote and coordinate standardization and safety of nanotechnology concepts and measurements
- Act as an advocacy group for nanotechnology in the region and for adequate regional representation of nanotechnology at global forums
- Initiate, promote and manage co-operative scientific and technology research projects within the member economies
- Enhance public awareness and education of nanotechnology and associated social, environmental, health and economic issues

Asia Nano Forum Summit is held annually hosted by one of its member organizations where high-level invited delegates from government, academia and industry gather to report on the latest developments of nanotechnology in ANF member economies. The ANF summit is a flagship event of great significance to the hosting member economy which receives strategic support from ANF for its nanotechnology development.

Working Groups

Standardization

To coordinate the cross-sector activities of ANF members for the purpose of facilitating the development of standards in the area of nanotechnology.
Through this working group, ANF is an official and very active member of ISO/TC229 and IEC/TC113 Standards for Nanotechnologies.

Coordinator: Dr. Bin-Cheng YAO (TANIDA, Taiwan)- mikebcyao@ntu.edu.tw

Nano Safety & Risk Management

To coordinate nanosafety activities in the region through the Asia Nano Safety network, including harmonization of nano safety training, safety-by-design approach to nanotechnology development and translational nano research to the marketplace. Also, to provide a coordinated response for community concerns and engagement on nanotechnology safety and risk management issues.

Coordinator: Dr. Paul WRIGHT (Australia) - paul.wright@rmit.edu.au
Dr. Wannee Chinsirikul (NANOTEC, Thailand) - wannee@nanotec.or.th

Commercialization

To realize economic value of Nanotechnology Research & Development through commercializing demand driven and technology push initiatives in partnership with the industry for sustainable development of ANF member economies.

Coordinator:
Dr. Rezal Khairi Ahmad (NanoMalaysia, Malaysia) - rezal@nanomalaysia.com.my
Mr. Alexander Pogany (BMVI, Austria) - alexander.pogany@bmvit.gv.at
Dr. Jun'ichi Sone (JST, Japan) - junichi.sone@jst.go.jp

User-Facility Network

To exchange and publish activities review of the facility networks and professional engineers in the industry and academia. (newly approved at ANF General Meeting in 2019)

Coordinator:
Dr. Yasuo Koide(National Institute for Materials Science (NIMS), Japan)- koide.yasuo@nims.go.jp

Member Organizations

Australian Nanotechnology Network, Australia

Austrian Ministry for Transport, Innovation and Technology (BMVIT), Austria

Japan Science and Technology Agency (JST), Japan

National Institute for Materials Science (NIMS), Japan

National Institute of Advanced Industrial Science and Technology (AIST), Japan

NanoMalaysia Berhad, Malaysia

National Nanotechnology Centre (NNC), Ministry of Energy, Science, and Technology, Environment andClimate Change (MESTECC), Malaysia

Industrial Technology Development Institute (ITDI), Department of Science and Technology (DOST) , Philippines

Korea Institute of Science and Technology (KIST), South Korea

Korea Nano Technology Research Society (KoNTRS), South Korea

Innovation and Application of Nanoscience Thematic Program, Taiwan

King Mongkut's University of Technology Thonburi (KMUTT), Thailand

National Nanotechnology Center (NANOTEC), Thailand

Institute of Tropical Technology, Vietnam Academy of Science and Technology, Vietnam

Asia Nano Forum Office Bearers (2018– 2019)

President
Toshihiko KANAYAMA
(AIST, Japan)

Vice President
T.K. LEE
(NSYSU, Taiwan)

Vice President
Peter MAJEWSKI
(Australian Nanotechnology Network, Australia)

Treasurer
Rezal Khairi AHMAD
(Nano Malaysia)

Secretary
Yukio KIMURA
(AIST, Japan)

Asia Nano Forum Executive Committee (2018)

CHENNUPATI Jagadish
(ANN, Australia)

Alexander POGANY
(BMVIT, Austria)

Jun'ichi Sone
(JST, Japan)

Yasuo KOIDE
(NIMS, Japan)

Byung-ki CHEONG
(KIST, Korea)

Kamarulzaman KAMARUDDIN
(NNC, Malaysia)

Blessie A. Basilia
(ITDI, Philippines)

Maw-Kuen WU
(Academia Sinica, Taiwan)

Wannee Chinsirikul
(NANOTEC, Thailand)

Asia Nano Forum Former Presidents

Founding Chairman
Kazunobu TANAKA
(JST & AIST, Japan)

Founding President
(2008-2009)
Maw-Kuen WU
(Academia Sinica, Taiwan)

President (2010-2011)
Hak Min KIM
(KAIST, Korea)

President (2012-2013)
Teruo KISHI
(ISMA, Japan)

President (2014-2015)
Sirirurg SONGSIVILAI
(NANOTEC, Thailand)

President (2016-2017)
Ramam AKKIPEDDI
(A*STAR, Singapore)

Other Founding Members

Founding Treasurer (2007-2010)
Hiroshi YOKOYAMA
Kent State Univ. USA

Founding Vice President (2007-2010)
Khiangwee LIM
NRF, Singapore

Venkatesh Rao AIYAGARI
India

Jane NIALL
Australia

Hong Khoi PHAN
Vietnam

Wiwut TANTHAPANICHAKOON
Thailand

Halimaton HAMDAN
Malaysia

✧ *Greetings from ANF President*

Dear ANF members,

To my great pleasure, here we present a new issue of ANF Annual Report 2019, owing to the invaluable contributions from many member economies. In this report, you will find survey of each Working Group, activities and policies of nanotechnology in member economies, enabling you to grasp what the ANF did under which circumstances in the past year.

This year, we held our summit meeting on May 27 in Tagaytay City, The Philippines, in front of a beautiful lake decorated with the smallest volcano in the world. On that occasion, we confirmed that such working groups of ANF as standardization, nanosafety, and commercialization are well supported and actively engaged by many ANF members. Yes, the working groups are certainly the heart of ANF. Thus to extend the scope, it was unanimously approved to launch a new working group, User-Facility Network working group. A highlight of the meeting was the election for next two years; the voting by all the member economies selected Prof. T. K. Lee, Taiwan as the reliable and experienced president, and other office bearers as well.

We also decided to have the next summit meeting in Wien (Vienna), Austria in July 2020 by courtesy of Department of Innovation, Industry, Science and Research (BMVIT), Austria. This will be a good opportunity to expand the activity outside Asia, on the basis of the past serial meetings on Asia-EU Dialogue on Nanosafety. I believe these decisions will further strengthen the activities of ANF and facilitate networking and collaborations. Please feel these new trends in this report, and I appreciate your proposals and inputs at any time and any occasion.

With best regards.

Toshihiko Kanayama

Toshihiko Kanayama

President, ANF

✧ *Working Group Report*

Commercialization Working Group

1. ANF Commercialization Workshop 2019, Tokyo

Asia Nano Forum (ANF) Commercialization Working Group Workshop, co-chaired by Jun'ichi Sone (JST, Japan), Co-chair: Hideaki Kitazawa (NIMS, Japan), was held on January 31, 2019 at Tokyo Big Sight. The ANF Commercialization Workshop aims to share the information on commercialization activities of emerging technologies of each country centered on Asia, particularly focusing on the activities of SMEs and venture companies, and to discuss the issues and promotion measures of the emerging technology commercialization. The workshop was open to the public with free charge.

ANF Commercialization Workshop 2019 was entitled with "Commercialization activities of emerging technologies of the regions centered on Asia, particularly focusing on the activities of SMEs and Startups".

At first, JETRO introduced their ecosystems and samples. And then, each startup presented his business and technology.

The presentation data is available at the following URL:
https://www.asia-anf.org/2019/02/11/nanotech-japan-2019-anf-exco-meeting-and-anf-nanotechnology-commercialization-workshop-summary/

The program of the workshop;

ANF Commercialization Workshop 2019
13:00 – 16:30, January 31, 2019
Room 608, Conference Tower (6F), Tokyo Big Sight
Organized By Asia Nano Forum
Chair: Jun'ichi Sone (JST, Japan), Co-chair: Hideaki Kitazawa (NIMS, Japan)
Organizer: Asia Nano Forum Commercialization Working Group:
J. Sone (JST, Japan), R. K. Ahmed (NMB, Malaysia), and A. Pogany (BVMIT, Austria)

13:00-13:05 Opening Remarks by J. Sone (JST)
13:05-13:30 JETRO's activities – Promoting Inward Foreign Direct Investment
K. Aono (JETRO)
13:30-14:30 "Metallic Glass Coating: A Great Nano-material for Various Application"
J. P. Chu (National Taiwan University of Science and Technology, Taiwan)
"Applications of nano hybrid resin"
J. C. Chu (GreenEpoxy Technology, Taiwan)
"Commercializing nanotechnology coating for automotive applications"
K. C. Chieh (Ominent Sdn Bhd, Malaysia)
"Creating business opportunities for nanotechnology based lubricant in Malaysia"
M.H. Yusman (All Season Synergy Sdn Bhd, Malaysia)
"Commercialization of nanotechnology wound care product for Malaysian market"
Z. Razak (Farmasia, Malaysia)
"Water Treatment for Self Sustaining Toilet"
C. K. Leong (Nanopac, Malaysia)

14:45-15:45 “Commercialization of Nanofibers produced by Hybrid Electrospinning”
Y. Song (Amogreentech Co., Ltd. , Korea)
“Silver Nanoprisms by Prime Nanotechnology"
N.Khupsathianwong (Prime Nanotechnology Co., Ltd., Thailand)
“High throughput screening business for new materials discovery and their applications"
T. Chikyow (COMET Inc., Japan)
“Minimal Fab - Innovative Semiconductor and MEMS Fabrication System"
N. Kobayashi (Minimal Fab Promoting Organization/Waseda University, Japan)
16:15-16:30 Closing Remarks by R.K. Ahmad (Nano Malaysia Berhad)

Invited speech by K. Aono (JETRO)

Invited speech by T. Chikyow (COMET Inc., Japan)

2. ANF Commercialization Workshop 2019, Phillipines

Asia Nano Forum (ANF) Commercialization Working Group Workshop, co-chaired by Jun'ichi Sone (JST, Japan) and REzal Khairi Ahmad (NanoMalaysia Berhad), was held on May 29, 2019 at at Taal Vista Lodge in Tagaytay City, Philippines in conjunction with ANF Summit and 2019 INTERNATIONAL NANOTECHNOLOGY CONFERENCE in the PHILIPPINES（INCP2019）.

The program of the workshop;
commercialization. The workshop was open to the public with free charge.
10:21 – 10:40
Nanotechnology Commercialization in Malaysia
Rezal Khairi Ahmad, PhD, Chief Executive Officer, NanoMalaysia Berhad, Kuala Lumpur, Malaysia

10:41 – 11:00
Commercial Applications of Physical Vapor Deposition and Plasma Nitriding in the Philippine Industry
Jonas Javelona, Beta Nanocoating Philippines Inc,
Laguna, Philippines

11:01 – 11:20
"Boysen Knoxout" The Air Cleaning Paint
Engr. Vergel Dyoco, Boysen, Inc., Philippines

11:21 – 11:40
Nanofixit Technologies
Mr. John Moe, NanoFixIt Ventures Inc., Philippines

11:41 – 12:00
Commercializing Rice-Husk derived Nano-Silica based Products
Dr. Daniel Bien, NanoQuartz Pte Ltd Malaysia

12:01 – 12:01
Nano-enhanced materials for Well-Being Market
Mr. Hafiz Zolkipli, Infusion Materials Lab Pte Ltd
Malaysia

Standardization Working Group

by Dr. Bin-Cheng Yao, ITRI, Taiwan

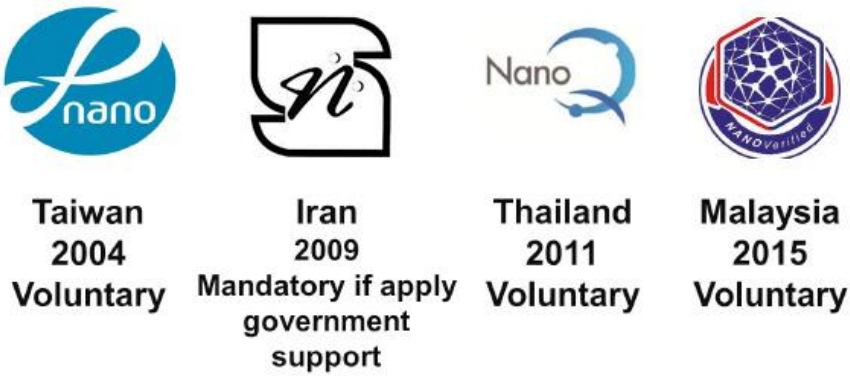
ANF Standardization working group has been collaborating with ANF members to facilitate the development of standardization in the field of nanotechnologies, such as inter-laboratory comparison and mutual recognition of certification. As the official liaisons of ISO/TC229 and IEC/TC113 WG3, ANF representatives have also been participating in the activities of Plenary Meeting and Interim Meeting every year to maintain the closest links with the latest development of nanotechnology standardization. The following are brief reports on events related to inter-laboratory comparison, certification activities, and status of ANF in ISO/TC229.

1. Inter-laboratory Comparison Activities

The Inter-laboratory Comparison, namely the 1st Call for Participation in Nanoparticle Size Characterization, was initiated in September 2017 by ANF and Thailand's National Nanotechnology Center (NANOTEC). The comparisons activity of polystyrene (4 types) and TiO2 (1 type) involved a total of 17 laboratories from Thailand, Iran, UK, Malaysia, Philippines, Indonesia, and Taiwan. Based on the collaborative efforts by ANF and NANOTEC, 14 laboratories from Iran, Indonesia, Malaysia, Philippines, and Thailand in the 2nd Call are currently making the comparison using AFM and TEM on gold nanoparticle (50-60 nm diameter). A workshop is scheduled to be held at NANOTEC in September to discuss the results. The organizer will receive USD 2,500 in sponsorship from ANF Nanosafety WG & SWG to hold the workshop and finish the final report in December.

2. Mutual Collaboration between nanoMark and NanoVerify

For the nano-enabled product certification programs among Taiwan's nanoMark, Iran's NanoMark, Thailand's NanoQ, and Malaysia's NanoVerify in ANF community, Taiwan and Malaysia are collaborating a new scheme for possible mutual recognition between nanoMark and NanoVerify. Taiwan's ITRI and Malaysia's MIMOS 1-TEM laboratories were accepted and qualified for the testing laboratories for mutual TEM testing lab. Both mark systems are opening for foreign company application. Still, there exist currently some coordination issues of requirements such as size and functionality for mutual recognition.



Nano-enabled product certification programs in ANF

3. ISO/TC229 and IEC/TC113: Liaison Status Changed

According to the new ISO and IEC Directives (Edition 15.0 2019-5), the rights and obligations of ANF in ISO/TC229 and IEC/TC113 has been changed respectively as follows.

As a **Liaison A at ISO/TC229**, the rights and obligations:

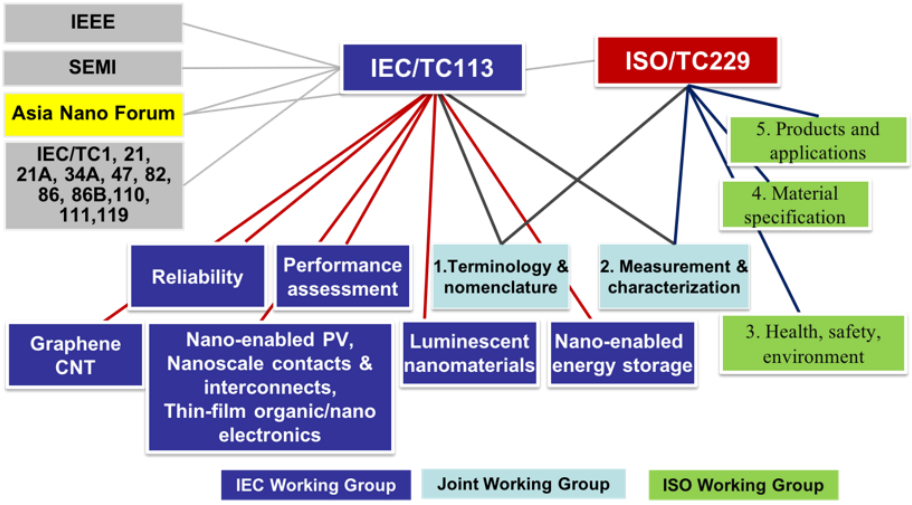
1. No voting rights, but can comment (comments are given the same treatment as comments from member bodies).

2. Can propose new work items.

As a **Liaison C at IEC/TC113**, the rights and obligations:

1. Can attend committee meetings if expressly invited by the committee, but only as observers.

2. Cannot propose new work items.



Frame of International Standardization ISO TC 229/IEC TC 113

4. The 21st ISO/TC229 Plenary Meeting 2018 in Malaysia

The ISO/TC229 Nanotechnologies 21st Plenary Meeting 2018 was held from 29 October to 2 November 2018 in Kuala Lumpur, Malaysia. Three experts from Taiwan on behalf of ANF participated in this 5-day event. There are currently five Working Groups (WGs) under TC229 which includes JWG1 (Terminology and Nomenclature), JWG2 (Measurement and Characterization), WG3 (Health, Safety and Environmental Aspects of Nanotechnologies), WG4 (Material Specifications), and WG5 (Products and Applications). Among five WGs of ISO/TC229, WG5 was recently created and aimed to describe how nanomaterials are enhancing their capability or functionality and then to develop performance-based standards for nano-enabled or nano-enhanced products and applications. This meeting WG5 specially invited Taiwan, Malaysia, and Iran to present their own system of nano product certification and performance valuation protocols used in these systems in the WG5 Strategy Meeting. The convener of WG5 also suggested Taiwan could come up with a proposal based on Taiwan's operation process of nano product certification and performance evaluation protocols used in the nanoMark system, the world's first nano-product certification system.

The 21st ISO/TC229 Plenary Meeting 2018 in Malaysia

5. ISO/TC229 & IEC/TC113 Interim Meeting in Australia

The ISO/TC229 WG3/WG4/WG5 with IEC/TC113 JWG1/JWG2 Interim Meeting was held on 13-17 May 2019 in Sydney, Australia. Being interested in ANF's general NanoMark systems, WG5 (Products and Applications) has invited ANF to propose a new working item idea. On behalf of ANF, Dr. Tsing-Tang Song from Taiwan in his briefing illustrated the Preliminary Working Item (PWI) proposal "Performance Evaluation of Metallic Surface Coatings Containing Nano Colloidal Sol - Corrosion Resistance" which is based on Taiwan's nanoMark scheme. Contributions for the ISO/TC229 New Working Item Proposal (NWIP) could be expected accordingly. Still, more efforts of simplification to fit the scopes of WG5 and continuous work with experts is necessary.

Nanosafety & Risk ManagementWorking Group

by Assoc. Prof. Paul Wright, RMIT University, Australia, Dr. Wannee Chinsirikul, NANOTEC, Thailand, and Taiwan

1. Taiwan participated in the 2nd EU-Asia Dialogue on Nanosafety

The 2nd EU-Asia Dialogue on Nanosafety promoted by EU-Nanosafety Cluster (NSC) and Asia Nano Forum (ANF) in EU and in Asia respectively was held on 29 October in Vienna, Austria. Nanosafety experts from European and Asian countries gathered to get insights on actual and future human and environmental nanosafety research, to then discuss in the breakout sessions, and how to progress towards thematic collaboration. The representative from Taiwan, a founding member of ANF, was invited to share Taiwan's developmental experience of nanosafety research. Some comments raised by Dr. C.S. Yang from Taiwan in the 4th Breakout session "Nanosafety and Nanomedicine Characterization" includes the importance of comprehensive physical-chemical characterization, the importance of novel techniques like high energy X-ray and liquid TEM, dimensional measurement of product with nano objects by using at least two different ways, advantage of Taiwan's advanced technology of Micro/Nano process and achievements on Organ-on-Chip in international nanosafety research. Through this dialogue between EU-NSC and ANF, it is expected to form further international collaboration with all efforts on development of international nanotechnology standards.

Taiwan participated in the 2nd EU-Asia Dialogue on Nanosafety

2. The Nanosafety Technical Forum in NanoThailand 2018 (12 December 2018)

ANF, Chulalongkorn University, Nanotechnology Association of Thailand, and NANOTEC organized the Nanosafety Technical Forum 2018 at Thailand Science Park as part of NanoThailand 2018. ANF provided travel sponsorship of USD 2,250 for six speakers from Japan, Korea, Malaysia, Philippines, Singapore, and Taiwan. NANOTEC also provided sponsorship for accommodation and local transport.

The event was held in conjunction with the 6th Thailand International Nanotechnology Conference (NanoThailand 2018). The objective of the forum was to convey information on nanosafety research initiatives, offer opportunities for discussion, explore the scope for mutual research collaboration activities, and promote awareness of nanosafety issues. The extraordinary chemical and physical properties of materials at the nanometer scale enable novel applications ranging from structural strength enhancement and energy conservation to antimicrobial properties and self-cleaning surfaces. Consequently, manufactured nanomaterials (MNs) and nanocomposites are being considered for various industrial uses. To achieve environmentally responsible nanotechnology in construction, it is important to consider the lifecycle impacts of MNs on the health of industrial workers and dwellers, as well as unintended environmental effects at all stages of manufacturing, consumption, and disposal.

The Forum consisted of the following presentation:

- "Intratracheal instillation method for testing nanomaterials"
  (Dr. Masashi Gamo, Senior Researcher, Research Institute of Science for Safety and Sustainability (RISS), AIST, Japan)

- “Method development for in vivo nanotoxicity assessment using zebrafish embryos”
  (Dr. June-Woo Park, Korea Institute of Toxicology)

- “Safety Evaluation across the Lifecycle of Manufactured Nanomaterials from the regulatory perspective”
  (Dr. Jahangir Bin Kamaldi, Advanced Medical and Dental Institute, Universiti Sains Malaysia)

- ZnO Nanoparticles Studies: Chronic Toxicity to Freshwater Calanoid Copepod Arctodiaptomus dorsalis and Antibacterial Activity against Uropathogens
  (Dr. Christina A. Binag, College of Science & Advanced and Nano Materials Laboratory Research Center for the Natural & Applied Sciences University of Santo Tomas)

- Health effects of engineered nanomaterials - using flies as a model
  (Dr. Baeg Gyeong Hun, National University of Singapore)

- “Chamber system for controllable and quantitative exposure of airborne nanoparticles for both the in vitro cell culture and in vivo animal studies”
  (Dr Jen-Kun Chen from the Institute of Biomedical Engineering and Nanomedicine (NHRI), Taiwan)

- “Silver nanoparticles lead to antibiotic resistance in bacteria”
  (Dr.Chitrada Kaweeteerawat, NANOTEC)

Over 80 participants from academia, research agencies, and regulators attended the forum. The participants gained updated information on nanosafety issues, exchanged research experiences, promoted networking, and established research collaboration opportunities.

The 6th Thailand International Nanotechnology Conference and Exhibition (NanoThailand 2018) was held during 12-14 December 2018 under the theme “From Frontier Research to Innovation and Commercialization”. The conference reflected the rapid advances being made in the field of nanotechnology, all for the goal of matching research with market needs. The event brought together

leading researchers, scientists, and innovators to exchange experiences and create an environment that promoted new ideas and collaborations. The participants were over 350 participants from 21 countries with 15 academic sessions and 21 exhibitors.

Ribbon Cutting Ceremony to open NanoThailand 2018, photo source: NANOTEC

Nanosafety Technical Forum 2018: photo session with speakers, photo source: NANOTEC

Keynote Talk by Dr. Jahangir Bin Kamaldi, Advanced Medical and Dental Institute,

Universiti Sains Malaysia, photo source: NANOTEC

3. The 3rd EU-Asia Dialogue on Nanosafety: Occupational Exposures to Manufactured Nanomaterials (MN) and Waste Disposal during ASEAN Next 2019 (18 March 2019)

The 1st EU-Asia Dialogue on Nanosafety was held in Tehran, Iran on the 28th of November 2017, followed by the 2nd EU-Asia Dialogue on Nanosafety held in Vienna, Austria on 29 October 2018. It was a great opportunity for Thailand to be selected to host the "3rd EU-Asia Dialogue on Nanosafety".

The 3rd EU-Asia Dialogue on Nanosafety was held during ASEAN Next 2019 at Pullman Hotel in Bangkok, and brought together nanosafety experts, from Asian and European countries. The aim of this dialogue was to exchange of information, knowledge and experiences as well as sharing resources between the major players from EU and Asian and to obtain insights on actual and future human and environmental nanosafety research.

ASEAN Next which was held during 18-22 March 2019 is an initiative of the Ministry of Science and Technology to promote responsible development of nanotechnology that educationally, socially, environmentally and economically benefits each economy. It aims to achieve this by fostering international network collaboration, with strong intentions to encourage discussion and cooperation among ASEAN members. ANF provided travel grant of USD 2,250 for six participants from Iran, Japan, Korea, Malaysia, Philippines, and Taiwan to attend the dialogue. NANOTEC also provided accommodation, meals, and local transportation.

The aim of the dialogue session was to provide a venue for discussion on various issues related to the session theme of "Occupational Exposures to Manufactured Nanomaterials and Waste Disposal". Over 70 participants from 16 nations (Asia, North America, and Europe) attended the dialogue session, which included technical lecture presentations follow by breakout sessions. These breakout sessions provided the opportunity for group discussions on four specific topics: Scientific Data Collaboration, Nano-Certification & Nano-standardisation, Social Dialogue and Governance, and Nanosafety & Nanomedicine Characterisation.

The following are some of the concerns and issues raised during the breakout discussions:

- Concerns about misuse of the data and quality of the available data,
- Standardisation procedure is a problem shared by all countries and need to increase ISO/TC229 participants
- Definition of nanosafety is too broad and must include other than toxicology, hazard assessment and regulatory aspects.
- Need for transparency and honesty when it comes to social dialogue.

Group photo with speakers and VIP guests, photo source: NANOTEC

ANF Summit Report

The 16th Asia Nano Forum Summit (ANFoS 2019) was held on May 27, 2019 at Taal Vista Hotel, Tagaytay City, The Philippines, hosted by the Department of Science and Technology-Industrial Technology Development Institute (DOST-ITDI), Republic of the Philippines. The 12th Annual General Meeting as the main part of the summit was held during the Summit program.

The ANFoS 2019 was held in conjunction with 2019 INTERNATIONAL NANOTECHNOLOGY CONFERENCE in the PHILIPPINES (INCP 2019) which was held on May 27-29, 2019 at the same venue.

During the decade since its foundation in 2007 in Singapore, the ANF played significant roles and acquired the firm presence in the nanotechnology community in Asia and related regions, thanks to the great effort of the founding members and their successors. This year's Summit and Annual General Meeting discussed how ANF continues and strengthens its activities for another prosperous decade and further.

Dr. Annabelle V.Briones delivered Welcome Remarks.

Outline of the 16th ANF Summit 2019 Program (ANFoS 2019)

27th May, 2019, Tagaytay, the Phlippines
Organized by: Asia Nano Forum (ANF)
In cooperation with and hosted by:
The Department of Science and Technology-Industrial Technology Development Institute (DOST-ITDI), Republic of the Philippines

Monday, MAY 27, 2019

09:00-12:00 ANF Annual General Meeting
13:15-18:00 ANF Annual General Meeting
18:00-20:0 Networking Dinner

Monday, MAY 27-29, 2019

INTERNATIONAL NANOTECHNOLOGY CONFERENCE IN THE PHILIPPINES 2019 (INCP 2019)
"NANOTECHNOLOGY FOR SUSTAINABLE DEVELOPMENT"

May 27, 2019 Advanced Materials Characterization Workshop
May 28, 2019 Welcome Remarks, Keynote Lecture, Plenary Lecture Sessions I, II, III
Cultural Nights
May 29, 2019 Plenary Lecture Session IV and V(Nanotechnology Commercialization Workshop)
SESSION I: Nanodevices, nanostructures for electronics, photonics, plasmonics
SESSION II: Nanosensors, Nanobiomaterials, and Nanomedicine
SESSION III: Trends in Nanotechnology
SESSION IV: Nanotechnology Characterization Workshop
SESSION V: Nanotechnology in Additive Manufacturing
SESSION VI: Nanotechnology Commercialization Workshop

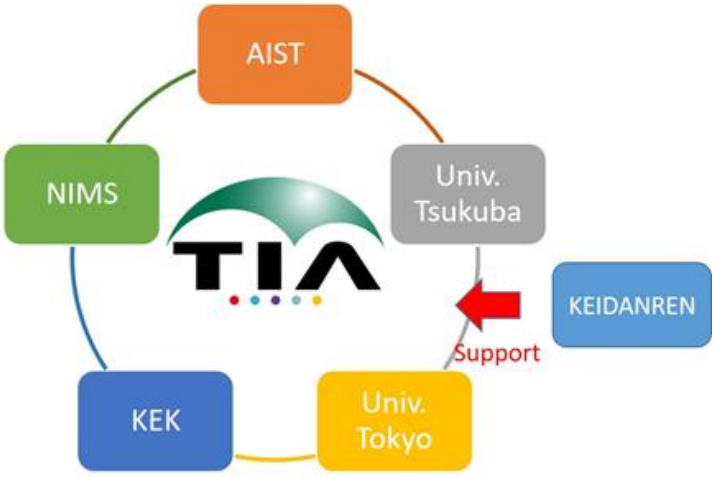
Partnership/Collaboration

Japan– Partnership/Collaboration

1. Tsukuba Innovation Arena (TIA)

TIA is an open innovation hub cooperatively operated by National Institute of Advance Industrial Science and Technology (AIST), National Institute for Materials Science (NIMS), University of Tsukuba, High Energy Accelerator Research Organization (KEK), and University of Tokyo as shown in the right figure[1]. It is supported by those institutions and the Japan Business Federation. TIA will combine the comprehensive R & D capabilities (human resources, facilities, intellectual property etc.) of the five organizations and will consistently support from creation of knowledge to industrialization. Since its establishment in 2009, TIA has made significant contributions to the practice of open innovation in numerous research fields such as innovative nano-device research and development based on super clean room (SCR) in AIST [2] and development of next generation aircraft materials through the use of light and quantum beam technology of TIA organizations [3]. 2019 is the 10th anniversary of TIA, and the last year of the second five-year-term. New vision for the next five years are being discussed. Here we would like to introduce two recent developments in TIA activities related to the activities of ANF.

Structure of TIA.



The first is the TIA collaborative research program "Kakehashi" which means bridging between different organizations in Japanese [4]. This project supports research study for five TIA core organizations to cooperate beyond organizational boundaries and develop new fields. Beginning in FY2008, TIA is seeking joint proposals from two or more organizations. TIA is looking for proposals for research and development in new fields such as Nanobiology, big data, etc. that can be pillars of future TIA activities, as well as proposals from conventional nanotechnology. The 39 projects were adopted from 79 applications in FY 2017, and the 50 projects including continuation were adopted in FY 2018. 52 projects were adopted in FY 2019. The adopted fields have expanded into new fields such as biotechnology, computational material science, big data analysis, integration areas, etc.

The second is Nanotech CUPAL (Nanotech Career-up Alliance), a human resource development program for nanotechnology [5]. The Nanotech CUPAL project has started since FY2008 in order to improve careers and improve mobility of researchers in the field of nanotechnology of 15 organizations (12 universities and 3 national research institutes) in Japan. TIA and Kyoto University are centers of industry-academia-government resonance fields in the area of nanotechnology. In the resonance fields, two courses are prepared as research and practical environments with advanced expertise and state-of-the-art equipment. The first is a collaborative research type NRP (Nanotech Research Professional) course aiming to train professionals who lead the creation of new knowledge, the second is a practical training type NIP (Nanotech Innovation Professional) course aimed at nurturing professionals who drive innovation creation.

In addition to the above two TIA activities, an activity of the user facility services project in Japan will be described. The "Nanotechnology Platform Japan (NTPJ)" [6] is the project by the Minister of Education, Culture, Sports, Science and Technology (MEXT) in Japan and is promoted for any of researchers from young to industrial one to do the share-use of the equipment, and to provide the shortest way to solve the urgent problems in science and technology. Therefore, all of scientists are invited to participate in this project to share equipment beyond the barrier of scientific communities and research organizations. In this program, 37 groups from 25 institutes and universities are joined and establish one single structure for "Share-Use Cutting-Edge Facility for Nanotechnology", which will be supported by MEXT for 10 years from 2012. Five excellent research results were selected and awarded in JAPAM NANO 2019 held in Tokyo on Jan. 30, 2019.

References

[1] https://www.tia-nano.jp/page/dir000002.html

[2] https://unit.aist.go.jp/tia-co/orp/index_en.html

[3] https://unit.aist.go.jp/tia-co/project/SIP-IMASM/index.html

[4] https://www.tia-nano.jp/page/dir000447.html

[5] https://www.nanotechcupal.jp/

[6] http://nanonet.mext.go.jp/ntj/english/

Korea– Partnership/Collaboration

1. NANO KOREA 2019

NANO KOREA, the largest international event in the field of nanotechnology in Korea was held in Goyang KINTEX I, in July, 2019with theslogans 'Nanomaterials, the building block for the future'.

Name	NANO KOREA 2019 - The 17th International Nanotech Symposium & Exhibition
Slogan	Nanomaterials, the building block for the future
Date	July 3rd(Wed) ~ 5th(Fri), 2019
Venue	Goyang KINTEX I, South Korea
Registration	1,961 people from 23 nations
Presentation	1,082 presentations(including 149 invited lectures) from 21 nations

Particularly this year, Technical Sessions were well organized with more specific topics compared to last year. Twelve technical sessions were successfully held to discuss the important issues in nanoscience and nanotechnology during the symposium. Also, a Tutorial Session entitled 'A Study on Advanced Nanomaterials Based on Big Data and Artificial Intelligence' was opened to provide 5 lectures for more than 50 audiences participating in the session. In addition, a public session was introduced in the program for the increased exposure of nanotechnology to the teenagers as well as a session designed to offer short hands-on experience on nanotechnology experiments.

NANO KOREA will continue to serve as a prominent national platform for disseminating and exchanging the latest research achievements and promoting the industrialization of nanotech-based products. The organizing committee plans to make the event more appealing with increased nano-convergence industrial contents, as the nano-based technology finds growing applications in the 4th Industrial Revolution.

2. The 2nd Korea-Japan-China TrilateralNanotechnology Cooperation Dialogue

Since the fouragencies (Korea Nano Technology Research Society, Korea Infrastructure Organization for Nanotechnology, Japan nanotech executive committee, China National Center for Nanoscience and Technology) signed in July 2015 a memorandum of understanding for the promotion of cooperation in science and technology among the three countries,Korea-Japan-China Nanotechnology Cooperation Forum has been held annually with participation of experts and researchers of nanotechnology in three countries to share the latest developments and to explore and update the cooperation issues.Following the first forum in January 27th, 2016 during Japan Nanotech 2016, the second one was held in August 29th, 2017 during China NANO 2017and the third onein July during NANO Korea 2018 in Goyang, Korea. This year, a short session was organized and held in Hanyang University last April to share each organizations' latest issues and discuss regarding 'CJK Trilateral Nanotechnology Cooperation Programs' for the future.

Name	The 2nd Korea-Japan-China Trilateral Nanotechnology Cooperation Dialogue
Date/Venue	April3rd(Wed), 2019/ Hanyang University, Seoul, South Korea
Attendances	23 people including the government officials and nanotechnology experts

3. Korea-Austria Nano Innovation Workshop

Korea-Austria Nano Innovation Workshop was co-hosted by the Embassy of Austria Commercial Section and Korea Nano Technology Research Society.About 15 participants joined the workshop while 6 experts from companies and governments of both countries presented their own businesses and projects related to nanotechnology. And all the participants discussed about how to establish the partnership and organize cooperation programs between 2 countries. Also, the workshop showcased funding programs for Korean researchers interested in doing joint research projects with Austrian partners.

Name	Korea-Austria Nano Innovation Workshop
Date/Venue	July3rd(Wed), 2019 / Goyang KINTEX I, South Korea
Attendances	About 15 participants including 6 experts from companies, government in Korea, Austria

Malaysia– Partnership/Collaboration

August 2018

Nanotech Talk Industrial Revolution 4.0 2018: Electrical, Electronic Devices, and Energy & Environment

NanoMalaysia Berhad organised a one-day nanotech talk session with Universiti Teknologi PETRONAS (UTP) in Kuala Lumpur. Among the invited speakers was Prof Vladimir Falko from the National Graphene Institute.

MOU between NanoMalaysia Berhad and USAINS Holdings Sdn Bhd

NanoMalaysia and USAINS (a subsidiary of USM - Universiti Sains Malaysia) signed an MOU for the production of High Purity Functionalised Multi-Walled Carbon Nanotubes (MWCNTs).

Presentation to Tun Dr Mahathir Mohamad, Prime Minister of Malaysia

NanoMalaysia Berhad, led by its Chairman, Prof Emeritus Dato' Ir Dr. Zawawi Ismail and CEO, Dr. Rezal Khairi Ahmad updated the Prime Minister of Malaysia on NanoMalaysia's strategies and activities.

September 2018

International Rubber Conference 2018

NanoMalaysia Autonomous Vehicle - NAVi was on static display at the Malaysian Rubber Board (MRB) booth at the International Rubber Conference 2018 at KLCC Convention Centre.

GraphChina 2018

The National Graphene Action Plan (NGAP) Office of NanoMalaysia participated in GraphChina 2018 at Xi'an, China.

October 2018

Graphene Malaysia 2018 & TC/ISO 229 & 206 Meetings

Graphene Malaysia 2018 was held on 29th and 30th October 2018 at Menara MITI, Kuala Lumpur. The flagship event under the National Graphene Action Plan 2020 was organised by NanoMalaysia Berhad and was supported by the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), Ministry of International Trade and Industry (MITI), the Malaysia International Development Authority (MIDA), and SCOPUS.

Graphene Malaysia 2018 saw the witnessing of an MOU handover between NanoMalaysia Berhad and Universiti Teknologi PETRONAS (UTP).

Four companies graduated under the National Graphene Action Plan 2020. They are Goodway Integrated Industries Berhad, DRB-Hicom Defense Technologies Sdn Bhd, SOL Polymer Sdn Bhd, and ACME Chemicals Sdn Bhd. The companies produced industrial products for applications in the areas of rubber, oil and gas, plastics and defence. The potential revenue for the four companies is RM2.8 billion, with more than 1,400 high-value jobs added.

Graphene Malaysia 2018

Fifteen local and 20 international speakers from the US, UK, South Korea, China, Spain, Taiwan, Singapore, France, and Japan presented on various topics on the graphene industry during the keynote and plenary sessions at Graphene Malaysia 2018. There was also an exhibition during Graphene Malaysia 2018 with more than 14 exhibitors participating.

During the same time, the TC/ISO Meetings on Nanotechnology (229) & Fine Ceramics (206) were held at Menara MATRADE, Kuala Lumpur.

Launch of Industry4WRD by Ministry of International Trade & Industry (MITI) NanoMalaysia's CEO, Dr Rezal Khairi Ahmad, was one of the moderators at the Launch of Industry4WRD. NanoMalaysia also participated in the exhibition during the launch.

November 2018

Visit by delegation from the Philippines

NanoMalaysia hosted a visit by a delegation from the Philippines consisting of representatives from universities and the Department of Science and Technology.

January 2019

Nanotech 2019 Japan & ANF Meeting

Nanotech 2019 saw the debut of the NanoMalaysia Pavilion at Tokyo Big Sight, Odaiba, Japan. The Pavilion showcased Malaysian companies offering nanotechnology products jointly commercialised by NanoMalaysia. There were 8 companies participated at the NanoMalaysia Pavilion namely NANOVerify Sdn Bhd, IGL Coatings (Ominent Sdn Bhd), Nanopac (M) Sdn Bhd, DERMAGS Skin Solutions (Biopro - UTM), Farmasia Sdn Bhd, Acme Chemicals(Malaysia) Sdn Bhd, All Season Synergy Sdn Bhd and IDC NETWORK
(M) Sdn Bhd.

There were also MOUs signed between NanoMalaysia and NanoNextNL from the Netherlands as well as between NanoMalaysia and NanoCanada. These MOUs established two international business and joint-development platforms for Nanotechnology companies from the Netherlands, Canada, and Malaysia to access European and North American markets, respectively.

NanoMalaysia also attended ANF Exco Meetings and Commercialisation Workshops.

February 2019

Visit by delegation from Nano Center Indonesia

NanoMalaysia hosted a visit by a delegation from the Nano Center Indonesia led by Prof Dr Nurul Taufiqu Rochman.

March 2019

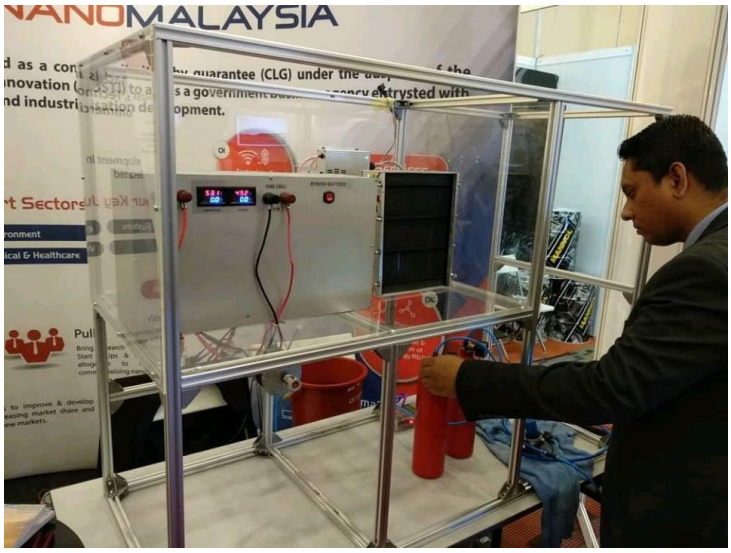
The signing of a Joint Venture and Shareholders Agreement between NanoMalaysia Berhad and MNA Research Sdn Bhd

NanoMalaysia Berhad and MNA Research Sdn Bhd have agreed to operate a joint-venture collaboration via a joint venture company named MNA Energy Sdn Bhd for production and commercialisation of backup storage graphene-based quantum cell (BSGQC) and graphene supply generators (GEG) for alternative supply application.

April 2019

Malaysia Autoshow 2019

NanoMalaysia and it's partners, Pulsar UAV Sdn Bhd and MNA Research Sdn Bhd displayed a demo unit of the Hybrid Energy Storage System (H2SS) blending graphene ultracapacitors, Li-Ion batteries and on-site hydrogen generated fuel cells.



May 2019

ANF Summit Manila & INCP 2019

Dr Rezal Khairi Ahmad, CEO of NanoMalaysia, presented the ANF Commercialisation Working Group 2018-2019 activities and the Country Presentation during the Summit.

ITEX '19

NanoMalaysia participated in the 30th International Invention, Innovation & Technology Exhibition, Malaysia (ITEX '19) held at the Kuala Lumpur Convention Centre. NanoMalaysia displayed the Graphene-based energy storage device for industrial and residential use developed by our partner, MNA Research Sdn Bhd.

June 2019

Graphene Rome 2019

Dr Rezal Khairi Ahmad, CEO of NanoMalaysia, was one of the invited speakers at Graphene Rome 2019.

Philippines– Partnership/Collaboration

1. DOST-ITDI hosts ANF Summit and INCP 2019

The bright minds in the field of nanotechnology gathered at Taal Vista Hotel in Tagaytay City, Cavite last May 27-29 for a back-to-back event co-organized by Department of Science and Technology-Industrial Technology Development Institute (DOST-ITDI), National Research Council of the Philippines (NRCP), and the Philippine Association of Microscopists, Inc. (MICROSPHIL).

The 16th Asia Nano Forum (ANF) Summit was held on May 27 at the Taal Vista's Ballroom 1, gathering representatives from the member countries from the Asia Pacific region for a closed-door meeting and presentation of each country's nanotechnology efforts and innovations. ITDI Director Dr. Annabelle V. Briones, who also delivered the Opening Remarks, represented the Philippines along with ITDI Materials Science Division Chief Dr. Blessie A. Basilia, who reported on Philippines' accomplishments via the ITDI Nano Lab. Other countries represented included Singapore, Thailand, Malaysia, Taiwan, Japan, India, Vietnam, and Iran.

ANF Summit 2019 Delegates

ANF Summit 2019 delegates pose before the famous Taal volcano

ANF's newly elected officers are Prof. Ting-Kuo Lee of Academia Sinica, Taiwan (President), Dr. Wannee Chinsirikul of NANOTEC, Thailand (Vice President), Dr. Yasuo Koide of NIMS, Japan (Vice President), Dr. Rezal Khari Ahmad of NanoMalaysia Berhad (Treasurer), Dr. Blessie A. Basilia of DOST-ITDI, Philippines (Secretary), and Prof. Jason Chang of Academia Sinica, Taiwan (Secretary).

ANF Office Bearers 2020-2021 (From left to right: Dr. Blessie A. Basilia of DOST-ITDI, Philippines (Secretary), Dr. Yasuo Koide of NIMS, Japan (Vice President), Dr. Wannee Chinsirikul of NANOTEC, Thailand (Vice President), Prof. Ting-Kuo Lee of Academia Sinica, Taiwan (President), Dr. Rezal Khari Ahmad of NanoMalaysia Berhad (Treasurer), and Prof. Jason Chang of Academia Sinica, Taiwan (Secretary)

On May 28-29, 326 participants from the academe, scientific community, and industry attended the International Nanotechnology Conference in the Philippines (INCP) 2019 at the hotel's Ballroom 1 and 2. Dr. Leah J. Buendia, DOST Assistant Secretary for International Cooperation, gave the welcome remarks, followed by the keynote lecture of ANF President Dr. Toshihiko Kanayama. Current advances and trends in nanotechnology from various countries were presented in five sets of plenary lectures. Also, held simultaneously in the afternoon of the 29th were six breakout sessions at the function rooms, where point-to-point business consultations were held between the experts and industry clients. There were also poster presentations and exhibits showcasing researches and suppliers' products.

Dr. Kanayama of AIST, Japan delivers his keynote lecture on "All Extremes Meet Nano"

Participants of INCP 2019 during the Plenary Sessions

Participants of INCP 2019

RRUdelaCruz/PANdeYro/ICOW

Taiwan – Partnership/Collaboration

1. Taiwan continued to participate in the M-ERA.NET

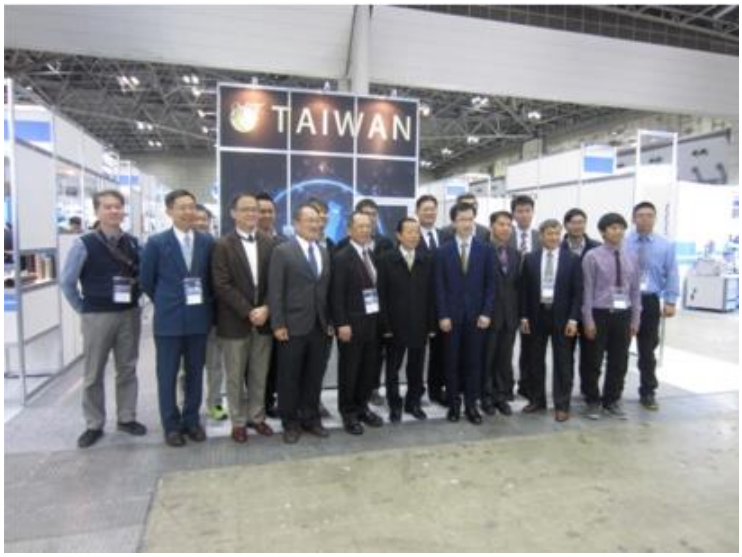
Dr. Jason Chang, representative of National/Regional funding organization of Taiwan, the Ministry of Science and Technology (MOST), continued to participate in the M-ERA.NET Joint Call Meeting and Steering Board Meeting held in Romania in September 2018 and in Italy in January 2019 respectively. All representatives gathered to determine the result of 2-stage proposal evaluations and other issues including budget, progress of working group, achievement review since 2012, and topics for Call 2020. Taiwan's MOST jointed as an observer in the same year as EU setup the M-ERA.NET program in 2012.

2. Taiwan hosted the Taiwan-US Nanotechnology Program Kickoff Meeting

2018 Taiwan/USAF Nanostructured Materials for Sensing and Sustainment -- Program Kickoff and Technical Exchange was held in December 2018. The new joint program "Taiwan/USAF Program on Nano-Structured Materials for Sensing and Sustainment" initiated by Taiwan's MOST and US Air Force Office of Scientific Research (AFOSR) has the Technology Readiness Level (TRL) between 1 and 1.5. Cooperation between Taiwan and USAF could be traced back to 2004. The past decade has witnessed a successful model to further international collaboration on nanoscience and nanotechnology between Taiwan and USA.

3. Taiwan in nano tech 2019, Japan

"nano tech 2019 – the 18th International Nanotechnology Exhibition & Conference" was held from 30 January to 1 February in Tokyo. A total of 19 new novel nano-materials, devices and techniques from 15 Taiwan's institutions/companies were selected to demonstrate Taiwan's latest nanotechnology status and offer visitors a better understanding of market opportunity in furthering business networking with Taiwan. In conjunction with nano tech 2019, representatives from ANF, Canada (Nano Canada), Germany (Fraunhofer-Dresden), Japan (Cabinet Office, JST, AIST, and NBCI), the Netherlands (NanoNexNL), Taiwan (TANIDA), and USA (NNI) also gathered at the "11th Nanotechnology Association Conference" hosted by NBCI (Nanotechnology Business Creation Initiative) to exchange each other's current practices and experiences.



Taiwan in nano tech 2019, Japan

4. Taiwan in ANF Summit 2019, the Philippines

The 16th Asia Nano Forum Summit (ANFoS2019) was held this May in the Philippines. Dr. Jason Chang, Director of Institute of Physics, Academia Sinica, had a briefing in the Country Report to illustrate Taiwan's post-National Nanotechnology Program status, including progress on science research, technology development, education cultivating, and nanoMark. Furthermore, Dr. Ting-Kuo Lee, Academician of Academia Sinica, and Dr. Jason Chang were elected the President and the Secretary of ANF Office Bearers 2020-2021 respectively. Following the ANFoS2019, Dr. Jason Chang was also invited to give a talk on "In situ Probing and Tuning the Physical Properties of Carbon Nanotubes" at the 2019 International Nanotechnology Conference in the Philippines (INCP2019) whose themes this year cover agriculture, environment, ecology, application and safety in industry, etc.

Taiwan in ANF Summit 2019, the Philippines

Thailand – Partnership/Collaboration by NANOTEC

1. Benchmarking Meeting on Nanosafety Project with Philippines at NANOTEC (19 March 2019)

On 19 March 2019, NANOTEC hosted a visit of a delegation from the Philippines headed by Mr. Marianito T. Margarito, Senior Science Research Specialist at Materials Science Division of Industrial Technology Development Institute (ITDI), Department of Science and Technology (DOST). The delegation was in Bangkok to conduct a benchmarking discussion in the area of nanosafety with NANOTEC's researchers including Dr. Wiyong Kangwansupamonkon, Dr. Annop Klamchuen, Dr. Sasithorn Aueviriyavit, and Mr. Ramjitti Indaraprasirt and visited NANOTEC's laboratories. The group consisted of:

1. Brigida A. Visaya - Industrial Technology Development Institute -Department of Science and Technology (ITDI-DOST)
2. Dr. Imee S. Martinez - Institute of Chemistry, University of the Philippines
3. Ms. Myra Mangabilin - Bureau of Philippine Standards, Department of Trade and Industry (BPS-DTI)
4. Ms. Edna C. Nacianceno - Philippine Council for Industry Energy and Emerging Technologies Research and Development, Department of Science and Technology (PCIEERD-DOST)

In addition to discussing with NANOTEC, the group also met Dr. Thanakorn Osotchan, the Chairman of NanoQ label, Nanotechnology Association of Thailand.

2. Industrial Networking on Nanosafety Seminar (12 June 2019)

NANOTEC hosted a seminar on Thai Industrial Networking on Nanosafety on 12 June 2019 in Bangkok. There were 2 speakers from Thai Industrial Standards Institute (TISI), and the Department of Industrial Works lectured on the topic of "Importance of the Industrial Standards for Products to drive Thailand 4.0" and "Department of Industrial Works to Promote Safety for Thai Industries". In addition, there were 3 researchers from NANOTEC to lecture and emphasized on to "Nanosafety for Health, and Environment" and "How to apply the Industrial Standards to the Nano Products in the Industry". The seminar drew a lot of attentions from more than 60 audiences from various organizations includind academic, government, and industrial sectors in order to develop to be the Nanosafety Networking Partners in the future.

3. Seminar on Increasing Economic Value for Paint and Coating Industry with Nano (24 May 2019)

NANOTEC and the Nanotechnology Association of Thailand, together with the Council of Science and Technology of Thailand (SSTAT) held a seminar on “Increasing Economic Value for Paint and Coating Industry with Nanotechnology Standards” in Bangkok on 24 May 2019. This seminar aimed at increasing paint and coating industry knowledge in the benefit of nano coating for value added and recognizing the trend of future innovation in the paint and coating sector. The Association also used this opportunity to launch NanoQ label for industries that produces nanoparticles for use as raw materials and hope to promote interest from local industries to apply for the NanoQ label.

Thailand – Partnership/Collaboration by KMUTT

1. Participated in 16th ANF Summit 2019 and International Nanotechnology Conference in The Philippines (INCP2019), May 26-29, 2019.

The committee team including Assoc. Prof. Werasak Suraruengchai, Dr. Non Thongprong and Dr. Nitipon came for the 16th ANF conference held at Taal Vista hotel, Tagaytay, the Philippines. The team presented the brief overview of frontier nanotechnology research at KMUTT, comprising biosensors, solar cell technology, wearable technology, and computational nanotechnology. Working under driving the scientific and technological capabilities of Thailand, KMUTT is working closely with National Science and Technology Development Agency (NSTDA) which is the state agency that is responsible for accelerating innovation in Thailand. During the presentation, the team informed that the KMUTT-NSTDA collaboration on biosensing research focuses on creating a promising device for urinary-related disease diagnosis and the disease follow-up management. The solar cell technology research at the university aims to advance the fabrication of perovskite-structured materials as an active layer for solar conversion efficiency. In the meanwhile wearable sensors have been initiated as smart electronic devices incorporated and embedded in clothing.

(a) General meeting atmosphere at the 16 th ANF Summit 2019 at Taal Vista hotel, Tagaytay, the Phillipines,

(b) The travel team included Assoc. Prof. Werasak Suraruengchai, Dr. Non Thongprong and Dr. Nitipon Puttaraksa (left to right) from KMUTT

Primitively at the ANF Summit 2019, Prof. Suraruengchai reported that KMUTT requested for the financial support to organize NanoThailand 2020 which will be hosted by the university on promoting the advancement of nanotechnology to Thailand innovation for smart healcare as illustrated in the left picture (a) in the following page. In addition, as shown in the right picture (b) in the following page, Prof. Suraruengchai requested to add a working group of Nano R&D and Frontiers to ANF in order to facilitate the development of nanotechnological standards in nanotechnology among ANF members in the region.

During the presentation by Prof. Suraruengchai (a) During a request of a financial support from ANF committee in organizing NanoThailand 2020 (b) During a suggestion to add a working group of Nano R&D and Frontiers to ANF.

2. Attended International Nanotechnology Conference in the Phillipines 2019 (INCP 2019) with the theme "Nanotechnology for Sustainable Development"

The KMUTT Nano team also attended several sections held at the conference. The conference highlighted recent advances and illustrated opportunities of utilizing nanotechnology to address global challenges, such as clean energy technology, material supply and utilization and green manufacturing and water purification.

General conference meeting INCP 2019 Taal Vista hotel, Tagaytay a) plenary lectures b) poster presentation c) registration area d) while participants gathered for a group photo

3. Organizing NanoThailand 2020 "Nanotechnology for Disruptive Change" hosted by KMUTT, July 23, 2019.

In the year of 2020, KMUTT has a privilege to host NanoThailand conference to promote nanotechnology exchange and collaboration between academia and industry. On this day, the nano committee team with key faculties gathered to organize the event. In the meeting, we determined what date the conference should start, how many participants can attend, who should be the keynotes and invited speaks and finding funding agencies. It would be great if ANF committee can partly provide some financial support for this important conference. With several advance topics will be exhibited at the conference, for example there are nanomaterials and nanofabrication, nanotechnology for renewable energy, graphene and carbon nanotube and biosensors. The aim of this NanoThailand is to integrate of engineering, material science and nanotechnology to address fundamental and advanced nanotechnological opportunities and future applications.

4. Establishing the Center of Excellence in Biosensing Research for Advanced Innovation.

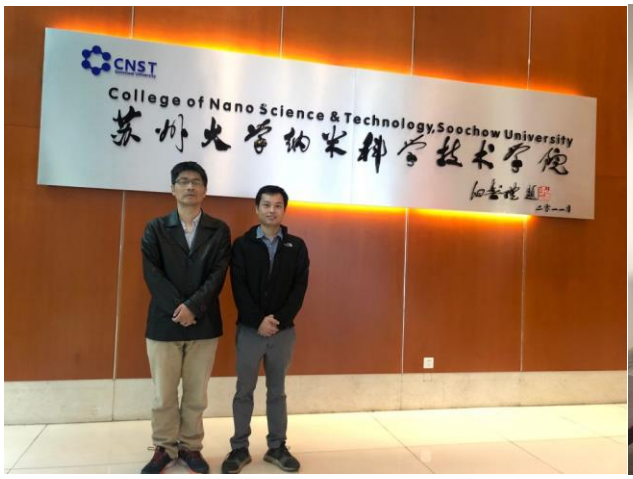
Led by Prof. Suraruengchai, the nano-biosensors laboratory provides opportunities for several M.Sc, Ph.D students and postdoctoral researchers across the ANF region to participate and work on their research projects. Within a decade, the laboratory has published in top-tier journals, including ACS Nano, Analytical Chemistry and Advanced Functional Materials. Recently, the group pioneered in driving nanotechnology research on microfluidic devices, wearable technology and innovation for smart healthcare. Currently there are several M.Sc, Ph.D and postdoctoral scholarships available at the university.

A group photo of the nano-biosensor lab members

All prospective students and postdoctoral fellows are welcome to join. The applying channel is http://nano.kmutt.ac.th

5. Establishing the Center of Excellence in Perovskite-Structured Fabrication and Surface Characterization.

Perovskite solar cells have recently become a focus of a vast research effort because of their high efficiency (as high as 20%) that is achieved using low-cost constituents. The team address the fabrication challenge via studying the mechanisms of perovskite crystallization bridging with computer simulation techniques.



Dr. Nopporn Rujisamphan and Dr. Non Thongprong visit college of nanoscience and technology Soochow University, China. During the visit, the team met Prof. Youyong Li, the research leader of Computational and Chemistry Materials and Design Laboratory.

Nanotech Policy

Japan – Nanotech Policy

1. 2019 edition of "Panoramic View of Nanotechnology and Materials Research Field" issued by CRDS/JST

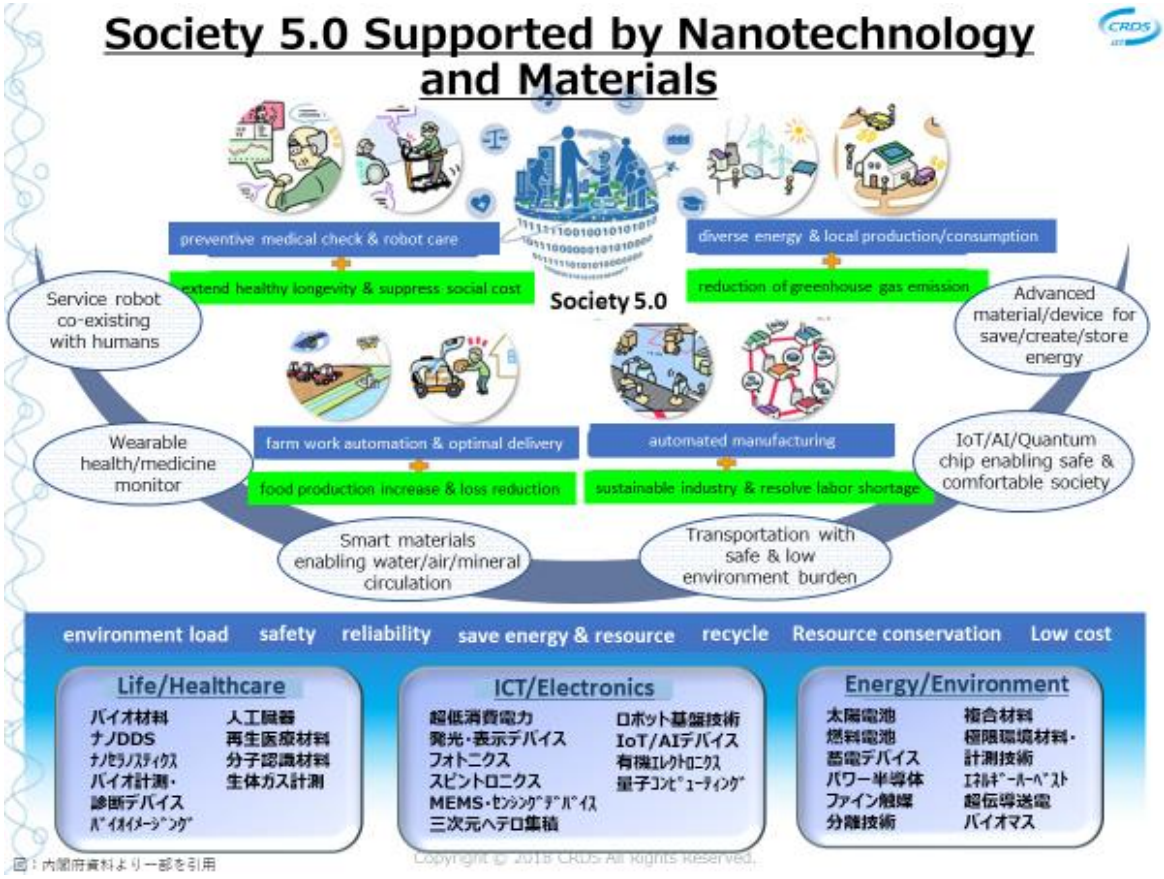
CRDS (Center for Research and Development Strategy) of JST (Japan Science and Technology Agency) issued the 2019 edition of "Panoramic View of Nanotechnology and Materials Research Field" (https://www.jst.go.jp/crds/report/report02/CRDS-FY2018-FR-03.html), where the latest technology trends and movements regarding nanotechnology and materials are updated, while following the position of the previous work of the 2017 edition and adding the viewpoint of how nanotechnology and materials can contribute for the realization of a sustainable society represented by SDGs. In the first chapter of the report, the overview of these trends and prospects in domestic and foreign research and development are described. In chapter 2, 32 major research and development areas in the nanotechnology and materials are reviewed, which summarizes the technological and industrial importance of the areas, historical background, current technology trends, future issues, and international comparisons (Japan, the US, Europe, China and Korea). These reviewing processes were conducted by gathering information and opinions of about 170 experts from industry, academia and government, making intensive discussions at workshops, and summarizing those views from the standpoint of CRDS.

The following is an overview of the chapter 1 regarding the recent movements of nanotechnology and materials. Twenty years have elapsed since the start of national policies for nanotechnology in many countries around the world in the beginning of 2000. In this period, the development of nanotechnology has been progressing steadily. As a result of these progress, many products based on nanotechnology have been created and commercialized. They are providing a large benefit to our society. In Japan, materials research has been intensively conducted for a long time and there are many achievements preceding the world in the development of new materials, which has supported and created the core industry of key materials and device components. We can raise many examples such as TiO2 photocatalyst, lithium ion battery, NdFeB permanent magnet, GaN blue LEDs, TMR head of hard disk, carbon nanotubes and so on, many of whose inventions and pioneering works were done in Japan. Particularly, the 2019 Nobel Prize in Chemistry were awarded to Dr. A. Yoshino together with Drs. J. Goodenough and M. S. Whittingham for their development of lithium-ion batteries. This achievement produced new energy industries which has brought a large benefit to humankind. Under such a background, there are many industrial areas in Japan that obtain a high worldwide market share mainly in the field of functional materials. In recent years, however, global competition for technology development is intensifying, it is strongly required to accelerate the speed of research and development even in the materials. A long period of time, typically 15 to 30 years is needed from the discovery of novel materials to social implementation through many time-consuming processes of completing prototypes, securing their reliability, and developing mass-production technologies. In this sense, it is expected that materials development using data science and computer science will play an important role to enable efficient and high-throughput development of novel materials. In addition, the progress of fabricating target structures on demands using 3D printing technology based on digitized design data is striking. Recent dramatic increase of computing power has brought a great impact on the design, synthesis, and manufacturing of advanced materials and devices.

As the IoT/AI era is about to arrive at its peak, the integration of cyber space software and physical space (real space) hardware in Cyber Physical System (CPS) becomes important. IoT devices embedded in our surrounding require sensing function and networking function for sending sensing information to the cloud side, as well as the energy harvesting function that acquires the electric power from the environment depending on the scene being used. In the operation of robots and autonomous car driving, instantaneous information processing and actions are required. In such a case, the IoT device itself will be equipped with advanced computing functions including AI, which exerts its strength in areas such as massive image / sound / video processing, AR/VR, natural language processing, optimization / reasoning, which are difficult with conventional computers. Expectations for new algorithms that exceed the von Neumann type computing and the hardware that carries out it are increasing worldwide. While the miniaturization of

semiconductors that have supported these developments has reached the limits, the need for a new technology to bear the post-Moor era is widely recognized. One of the candidates for these novel computing technologies is the neuromorphic computing which executes the information processing at extremely low power consumption and the other candidate is the quantum computing which gives a solution to the complicated processing practically difficult to solve at the current computer by operating basic elements to work in accordance with the principle of quantum mechanics. Expectations are increasing for contribution from nanotechnology/materials science and technology in these developments.

Through these studies on the front end of nanotechnology and materials and on the social and industrial expectations, we extracted six social needs that we are facing and major research and development areas of nanotechnology and materials to strategically address to solve those needs, which are shown in the figure below.

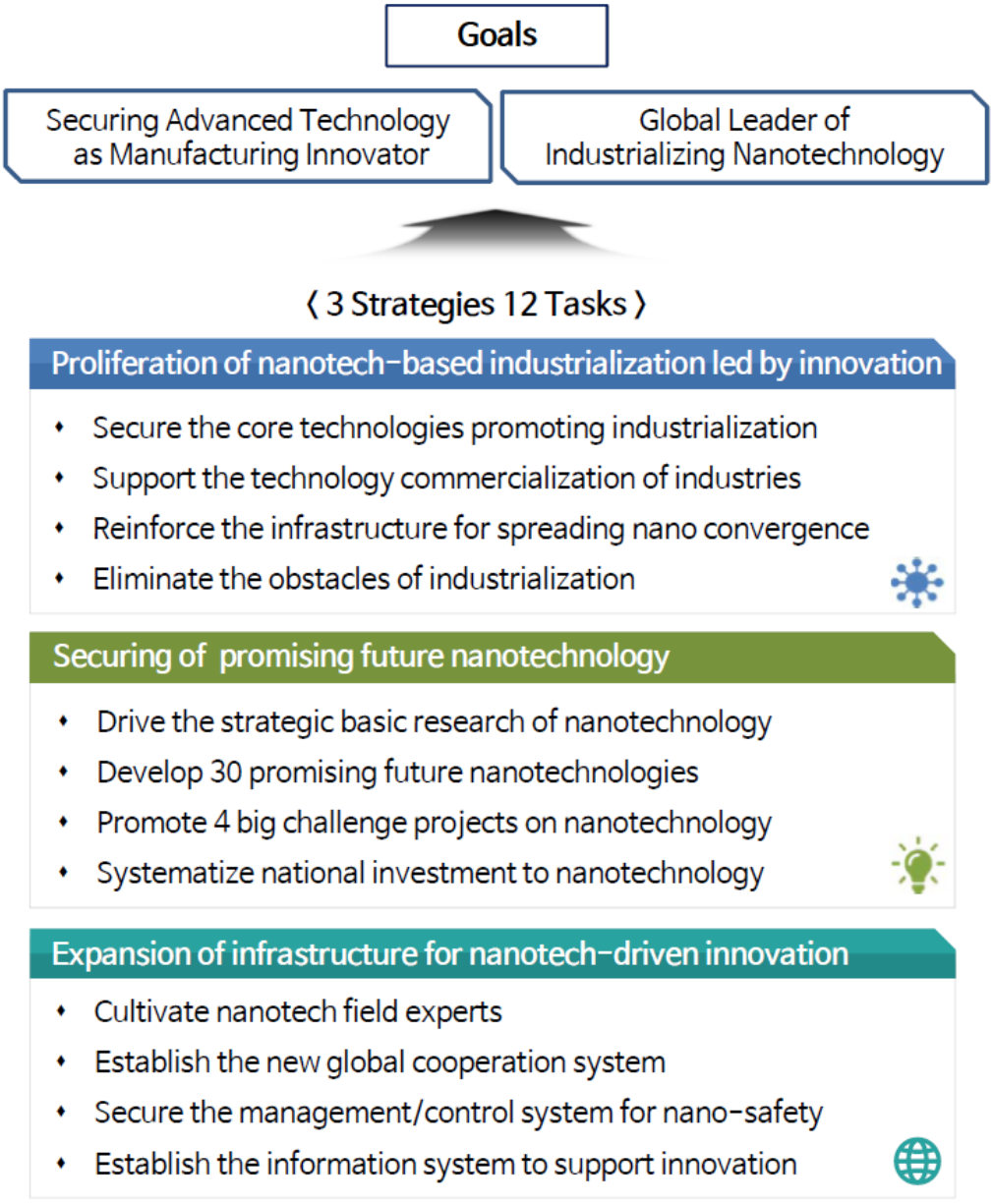


図：内閣府資料より一部を引用

Korea – Nanotech Policy

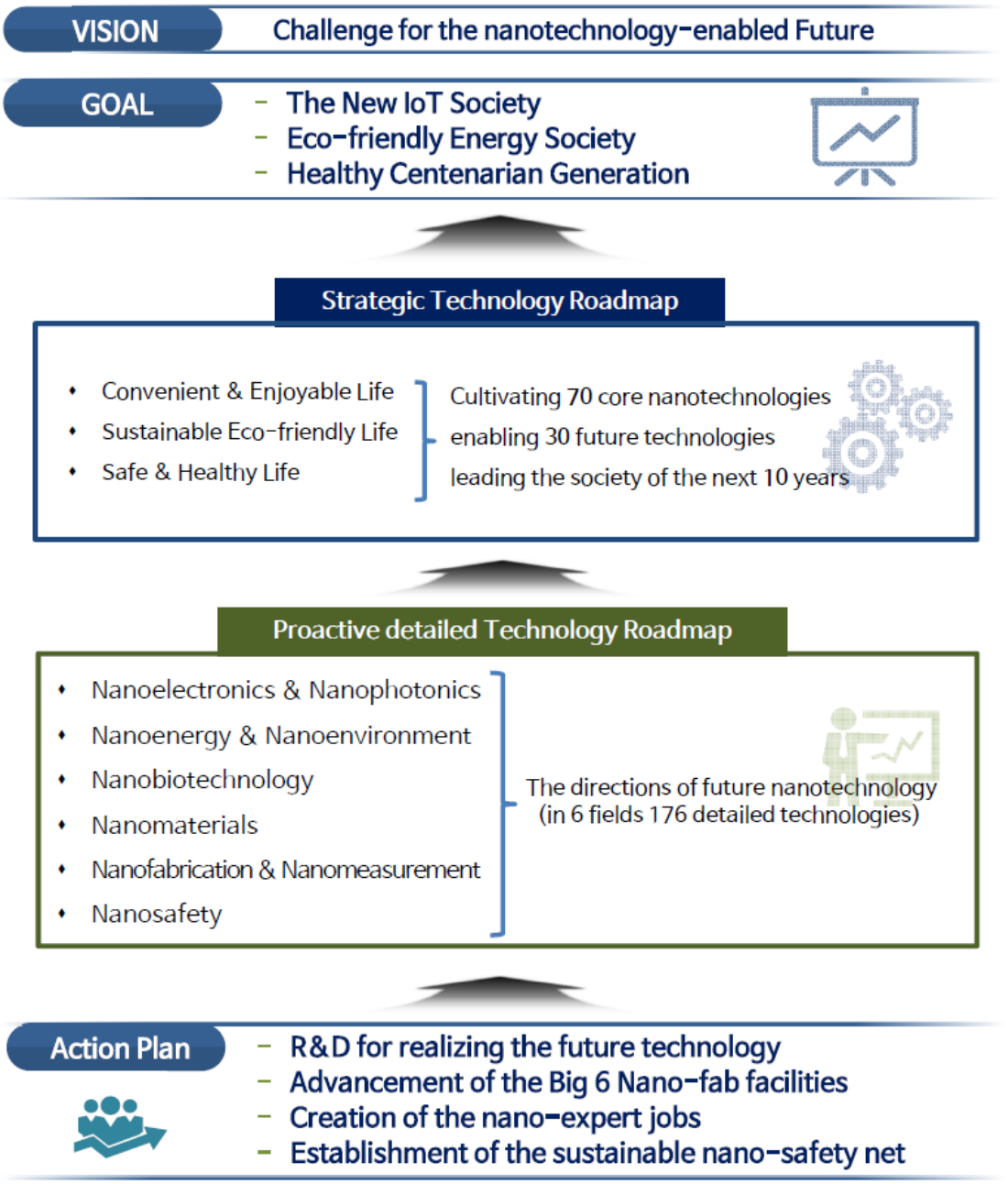
1. National Comprehensive Development Plan on Nanotechnology

The fourth decadal national plan on the comprehensive development of nanotechnology was enacted in 2016 following the preceding three plans. The new plan for the 2016-2025 decade named Korea Nano Innovation 2025 reflects the internal and external changes in the socio-economical and technicalenvironment of the emergingeraand lays out vision, goals and key tasks of the next decade.The plan aims to promote the dissemination of the mature, qualifiednanotechnology to the manufacturing sector and to take the lead in nanotechnology-driven innovation globally by early investments in promising advanced technologies.



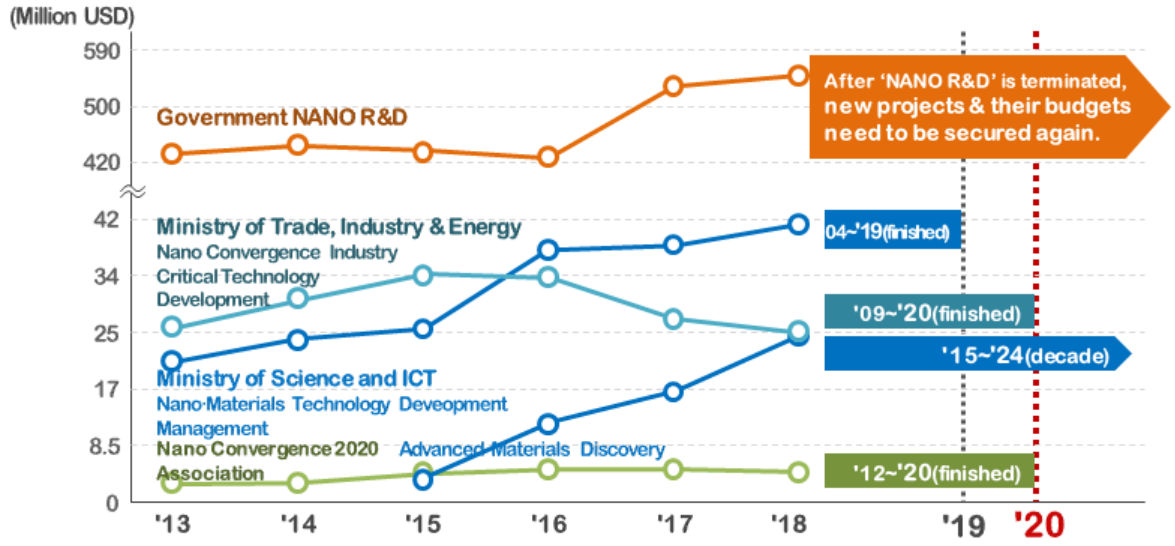
2. Nanotechnology Roadmap

In order to guide the nation's innovation-driven growth by cultivating the key nanotechnology, the Ministry of Science and ICT of Korea has established the 3rdNanotechnology Roadmap by joint cross-ministry collaboration, and the Roadmap has been approved by Presidential Advisory Council on Science & Technology in June 2018, followingthe first and the second Nanotechnology Roadmap published in 2008 and 2014, respectively.



3. Recent Trends in Nanotechnology R&D Management of Government

Since most of nanotechnology R&D projects of Korean Government will be finished around 2020, new projects have been planned and organized recently by Korean Government via collaboration with various organizations.



Ministry of Science and ICT, Ministry of Trade, Industry & Energy have organized new R&D projects to encourage the development of nanotechnology fields in Korea as below.

Source Technology Development of Nano Advanced Materials

- Organizers : Ministry of Science and ICT, Korea Nano Technology Research Society
- Period : '2020~'2031
- Budget : $ 386 million
  (Private Capital : $ 8 million / National Treasury : $ 378 million)
- Vision and Aim
  - (Vision) Source technology development of nano advanced materials for future innovation
  - (Aim) Securing more than 20 global source technology development of nano advanced materials

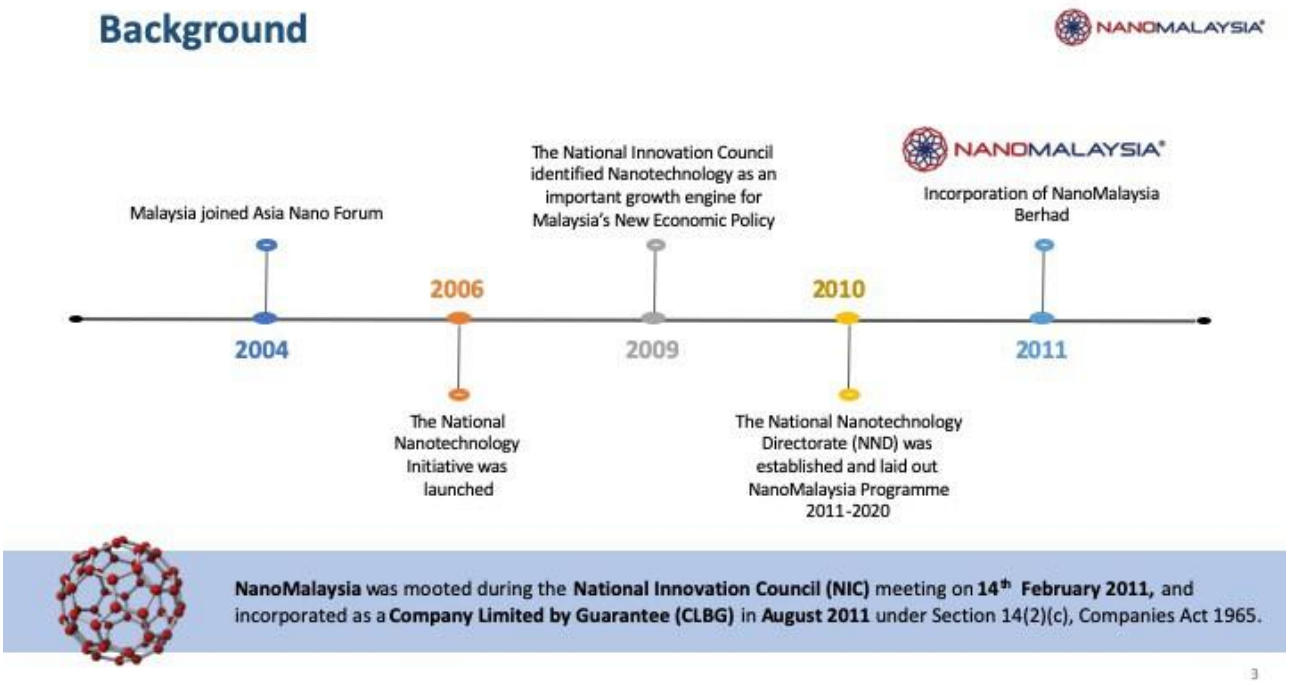
Nano Convergence Innovative Products Technology Development Project

- Organizers : Ministry of Trade, Industry & Energy, Korea Evaluation Institute of Industrial Technology
- Period : '2021~'2025
- Budget : $ 315 million
  (Private Capital : $ 93 million / National Treasury : $ 221 million)
- Aim
  - Development of nano convergence innovative products (Parts & Modules) technology demanded by various industries

Malaysia – Nanotech Policy

1. Malaysia - NanoMalaysia 11th Malaysia Plan Commercialisation Programme

NanoMalaysia Berhad was incorporated as a Company Limited by Guarantee (CLBG) under the Ministry of Science, Technology and Innovation (now known as the Ministry of Energy, Science, Technology, Environment and Climate Change - MESTECC) in 2011 as Malaysia's lead agency to commercialise nanotechnology.



NanoMalaysia aims to Re-Energise Industries through:

- Economic Growth and Commercialisation

1. Develop and promote nanotechnology as a new source of national economic growth.
2. Promote and support commercialization and production of nanotechnology R&D activities.

- Ecosystem and Competitiveness

1. Establish, provide and maintain a nanotechnology ecosystem for product R&D&C.
2. Maintain and enhance Malaysia's nanotechnology competitiveness in the global market.

- Public Awareness and Joint-Development Efforts

1. Provide public awareness, education and training services in nanotechnology.
2. Promote, support, mobilise and manage joint nanotech development efforts.

2. NanoMalaysia's Mandate

Effective 16th May, 2013, NanoMalaysia is mandated as per P.U. (A) 184/2013 - Ministers of the Federal Government (No. 2) Order 2013 (p.105-106) to:

- Act as a business entity entrusted to focus on the commercialisation and development of nanotechnology

- Plan and coordinate **the commercialisation of R&D of nanotechnology** in high-impact areas of focus such as electrical and electronics, food and agriculture, energy and environment, and health and medicine

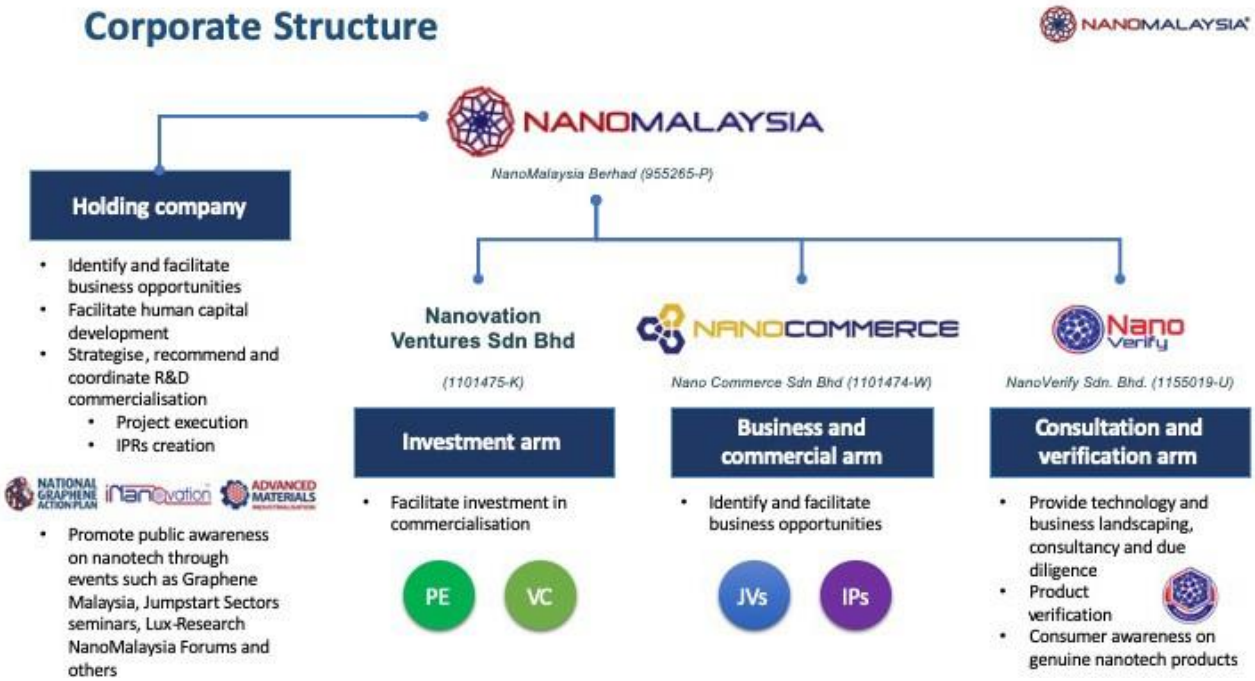
- Plan and manage activities that contribute to the **development of nanotechnology-based industries.**

- Strategise the positioning of nanotechnology industry of Malaysia in the global supply and value chain.

- Facilitate investment in nanotechnology commercialisation.

- Facilitate the **development of human capital** (scientists and engineers, researchers and professionals) in the nanotechnology industry.

Corporate Structure of NanoMalaysia

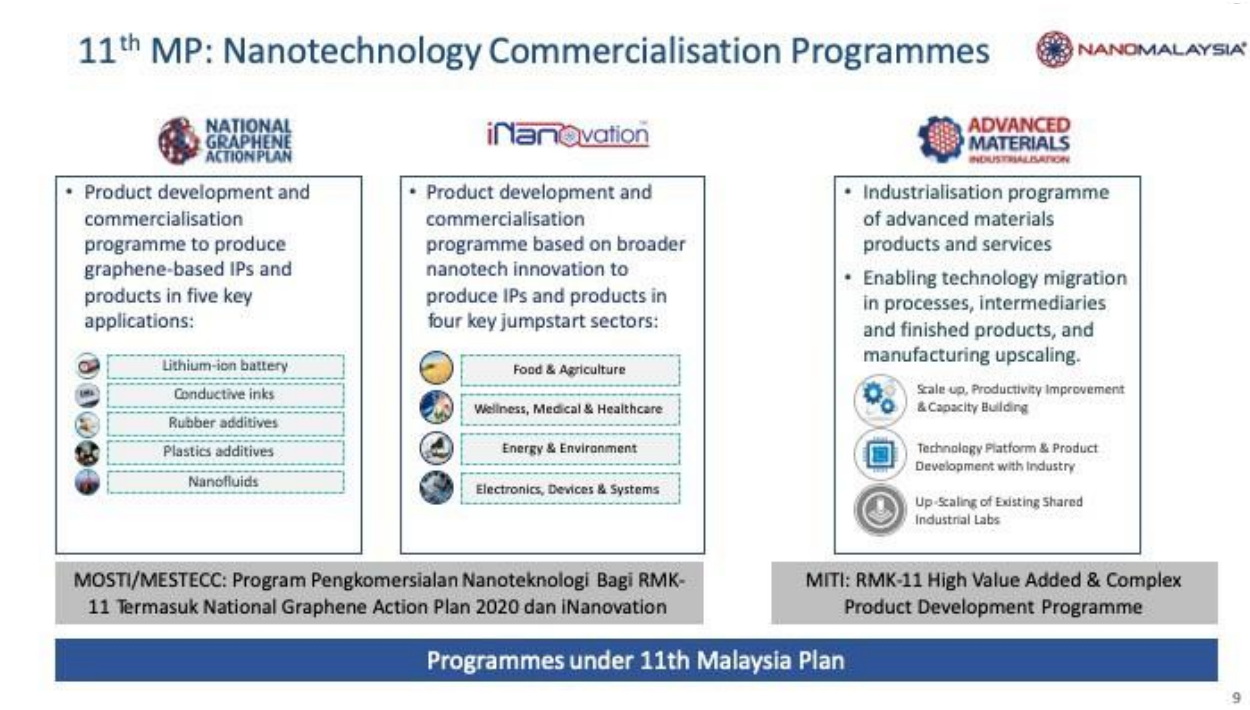


3. Nanotechnology Commercialisation Programme

To assist companies in Malaysia through nanotechnology commercialisation and development, NanoMalaysia has introduced several programmes under the 11th Malaysia Plan (2011-2020). The programmes are:

1. iNanovation programme
2. National Action Graphene Plan (NGAP)
3. Advanced Materials Industrialisations
4. NANOVerify Programme.

These programmes will focus on four key sectors, namely Electronic Devices & Systems, Energy & Environment, Food & Agriculture, and Wellness, Medicine & Healthcare.



Projects Types Under the Commercialisation Programme

Product Development

- Product Development projects are proof-of-concept or prototype development projects for a product or technology to enter into pre-commercialisation phase.

- Maximum funding for a Product Development project is RM 500,000 in the form of project investment.

- Applicable programmes and iNanovation dan National Graphene Action Plan 2020.

- Funding covers:

- Technology due diligence
- Business due diligence
- IP rights verification
- Product fabrication
- Product testing and nanotech verification
- Procurement of raw materials
- Procurement of equipment
- Consultancy fees
- Contract research consultancy
- Nanotechnology and advanced materials workshop
- Graphene workshop

Scale-Up

- Scale-Up projects are industrialisation projects for pilot build or manufacturing scale-up for a proven product or technology to enter into commercialisation phase.

- Maximum funding for a Scale-Up project is RM 1,000,000 in the form of project investment.

- Applicable programmes are iNanovation and National Graphene Action Plan 2020.

- Funding covers:
- Consultancy fees
- Procurement of raw materials
- Procurement of equipment
- IP rights mapping
- Market research
- IP licensing
- Product improvement towards industry standards
- Nanotech or graphene verification
- Contract research consultancy
- Nanotechnology and advanced materials workshop
- Graphene workshop

National Graphene Action Plan (NGAP)

National Graphene Action Plan (NGAP) is a commercialisation programme focusing on Graphene applications in five application areas:

- Lithium-ion battery anodes / ultracapacitors
- Conductive inks
- Rubber additives
- Plastics additives
- Nanofluids

The aim of NGAP is to enhance downstream applications relevant to Malaysia and eventually to enable a local Graphene eco-system to accelerate downstream adoption.

iNanovation

iNanovation is designed for the industries, small and medium enterprises (SMEs) and start-up companies to establish market share, introduce new process/material and switch from current conventional to nanotechnology-enabled through the iNanovation platform. The platform consists of pushing nanotechnology products and services into the market, improve products, increasing market share and venture into new markets, and enhance its current production process from conventional manufacturing to the nanotechnology-enabled process. This facilitation scheme includes venture funds, soft loans, business partners, and technology expertise.

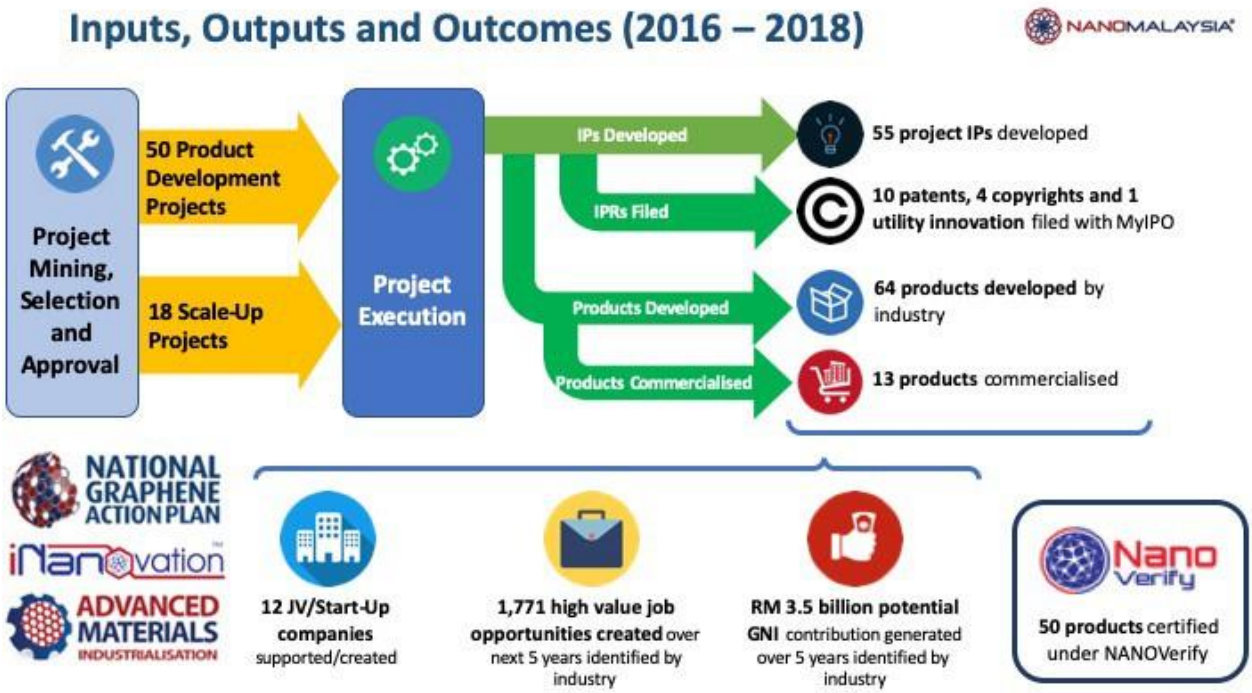
Advanced Materials Industrialisation

Advanced Materials Industrialisation Programme provides exclusive services through technology adoption of Industrialisation of Advanced Materials products. The program also provides governance, avoid consumer confusion, and market advantage to local manufacturers through verification and certification in terms of nanotechnology adoption. Some of the services include Scale-up, Productivity Improvement & Capacity Building; Technology Platform & Product Development with Industry; Up-Scaling of Existing Shared Industrial Labs, and enhancement of the NANOVerify Programme.

NANOVerify Programme

The NANOVerify Programme is a voluntary certification programme for processes and products with claims of nano-elements in the range of 1 to 100 nm, as well as performance enhancements related to such elements. The "NANOVerified" mark will be awarded to the processes and products upon successful completion of the NANOVerify programme. The programme aims to help genuine nanotechnology-based products in the market, increase public trust in new technology, facilitate and certify the presence and quality of nanomaterial-based products and services.

Inputs, Outputs & Outcomes (2016 - 2018)



REVOLUTIoNT 4.0

In the 4th Industrial Revolution, NanoMalaysia aims to continue to energise and re-energise industries and innovation in Malaysia through successful development and commercialisation of nanotechnology especially in the adoption of the "Internet of Nano Things" (IoNT). Under REVOLUTIoNT 4.0, NanoMalaysia is heading the revolution of the Internet of Nano-Things in Malaysia through various applications in several industries including transportation, healthcare, agriculture, and services.

Taiwan – Nanotech Policy

1. Taiwan's IANTP to the next stage

Initiated in 2015 and under the auspices of the Ministry of Science and Technology (MOST), Taiwan's Innovation and Application of Nanoscience Thematic Program (IANTP) is reaching the next stage and reviewing the implementation strategies. In addition to current funded research from a basic "Concept Development" of Technology Readiness Level (TRL) to a more advanced "Prototype Validation", some added priorities are expected to strengthen IANTP's advantage, including fundamental issues for product or developing technology and development of crucial equipment or key technology for solving scientific or industrial problems between TRL2 and TRL4. Furthermore, a new program "Taiwan Accelerator Plus (TAcc+)" launched by Ministry of Economic Affairs (MOEA) in 2018 also provides a connecting professional service between researcher and entrepreneur, such as free startup workspace, experienced mentors and abundant capital network, to help make a competitive team for startup. By matching these policy programs, it is expected to inspire researchers' in-depth thinking of technology commercialization and to achieve their entrepreneurial ambition

2. Academia-Institute-Industry innovative R&D

By learning from the technology cooperation platform of Horizon 2020, Taiwan Nanotechnology Industry Development Association (TANIDA) built an innovative R&D platform linking up academia, institute and industry (especially SME) to help assess the preliminary business model from results of innovation and application beyond TRL 2-4, and develop towards commercialization. In addition to the "Low-carbon Circular and Novel Functional Materials Forum" and "2018 Nanomaterials and Production Application Forum and Product Show" held in October 2018 and in December 2018 respectively, an international workshop focused on biosensor for rapid detection in the upcoming October would be a pilot activity of this partner network between the enterprise and academia and is expected to find solutions to critical problems during the process of commercialization of innovative application. TANINDA aims to facilitate the integration of R&D efforts at universities, research institutions and industry to accelerate the commercialization of nanotechnology and to meet industries' needs of developing high valued-added products and technology. In early 2017 Taiwan's Nano Mark established in 2003, also the world's first nano-product certification system, was transferred to TANIDA for the professional and independent functionality after 13-year operation under the auspices of the government. Dr. Ting-Kuo Lee, current Vice President of ANF, was elected Chairman of TANIDA at the TANIDA Plenary Meeting in October 2018.

2018 Nanomaterials and Production Application Forum and Product Show

Thailand – Nanotech Policy

Nanotechnology Policy in Thailand

In advancing the country to Thailand 4.0, the government aims to support nanotechnology research focusing on agricultural and industrial products for economic and social sustainability. There are several factors contributing to nanotechnology development in Thailand. First, it is the strategic location. Inevitably, Thailand locates at a heart of Asia capturing a big market and attracted almost 600 million consumers a year. Thailand is a major exporter of food, clothes, natural rubber, refined petroluem, rice and raw sugar. With this trend, Thailand will continue growing given strong economic fundamentals in several sectors. Second, Thailand has an excellent infrastructure. The country has built infrastructure to world class standards, which supports the growth of key economic sectors and has led to the development of comprehensive industrial clusters. Modern industrial estates, state-of-the-art transportation, communication facilities, and logistics system help achieve cost-effective business operations. To ensure effective implementation of the national nanotechnology policy, the following visions and goals have been identified.

1. Advancing agricultural technology and manufacturing industry that meet the need of the market through nanotechnology.
2. Exploiting nanotechnology to develop nanostructured-materials, commercial products, and the country-made equipments in order to enhance the quality of people life, wellness, and environment.
3. Becoming ASEAN’s leader in nanotechnology research and education.

Vietnam – Nanotech Policy

Nanotechnology Policy in Vietnam

Considering the huge impact of nanotechnology on global market and national economies of various countries, most of developed and developing economies have established strategies and encouraging commercialisation plans. Vietnam is among developing countries recognizing the future impact of this very important field on the nation's wealth and development. In the last 12 months, many nanotechnology activities such as education, national and international conferences, commercializing nanotech-based products…have been held in Vietnam. Followings are the representative nanotechnology activities in the past 12 months in Vietnam:

1. Education

Human resources are one of the basic requirements for any development plan. Many university and institutes in Vietnam provide a package of supports for students, researchers, academic staffs, which attract the great attention of academia and postgraduate students towards nanoscience and nanotechnology. Now more than 50 universities and research institutes are engaged in the areas amongst MSc programs and PhD courses in this field. Furthermore, nanotechnology education also has other supporting packages for nanotechnology related job training as well as sabbatical leaves. These supporting schemes have had a remarkable impact on the developing status of Vietnam in terms of science generation.

2. National and International conferences, workshops and seminars

Many national and international conferences, workshops and seminars on nanotechnology has been held in Vietnam during last 12 months. The typical conferences and workshops are listed as following:
- The collaborations between Institute of Tropical Technology (VAST) and INM (Belarus Academy of Science) on the primary project of "new ecologically safe film-forming compositions based on natural polysaccharides, applications for food packaging and seed treatment.
- An effort has been initiated to network accredited laboratories within the ASEAN member states (Vietnam, Thailand and Malaysia) for a cost-effective utilization and offering of testing services to industrial customer regionally and internationally by complying with OECD-GLP or ISO/IEC 17025 quality assurance standards.
- SATREPS project between Vietnam and Osaka university on the monitor of air quality in Hanoi using nanosensors.

Fig.1 Collaboration meeting between VAST and Osaka university on the SATREPS projects

3. Applications and nano-based products

- Trial application of nanotech-based bioreactor for the treatment of To Lich river, Hanoi, Vietnam

Fig. 2 Japanese experts install nanotechnology equipment on the bed of To Lich River.

The Nano-Bioreactor technology, provided by Japanese experts, produces oxygen in the water by activating both aerobic and anaerobic microorganisms in the water. Equipment use includes an aerator to quickly treat water using natural materials, which is installed on the bed of the river.

- Many nao-based products have been launched in Vietnam: nanographene, nano silver, nanocurcumin, nanochitosan…

Fig.3 Launching of the first graphene company (VNgraphene) made in Vietnam

MAJOR EVENTS 2018-2019

Date	Avenue	Events
10/7/2018-13/7/2018	Seoul, South Korea	**NANO KOREA 2018**
29/10/2018	Vienna, Austria	**The 2nd EU-Asia dialogues on Nanosafety**
30/10/2018	Manama, Bahrain	**International Waqf and Blockchain Forum (IWBF)**
12/12/2018-14/12/2018	Pathum Thani, Thailand	**Nanosafety Technical Forum 2018 at NanoThailand 2018**
30/1/2019-1/2/2019	Tokyo, Japan	**nano tech 2019**
30/1/2019	Tokyo, Japan	**1ST GERMAN-JAPANESE NANOTECHNOLOGY COMMERCIALIZATION WORKSHOP**
31/1/2019	Tokyo, Japan	**ANF EXCO Meeting**
31/1/2019	Tokyo, Japan	**NBCI THE 11TH NANO TECH ASSOCIATION CONFERENCE**
31/1/2019	Tokyo, Japan	**ANF Commercialization Workshop**
18/3/2019	Bangkok, Thailand	**The 3rd EU-Asia Dialogue on Nanosafety**
3/4/2019	Seoul, South Korea	**The 2nd Korea-Japan-China Trilateral Nanotechnology Corporation Dialogue**
28/5/2019	Tagaytay, Philippines	**Asia Nano Forum Summit 2018**
29/5/2019	Tagaytay, Philippines	**ANF Commercialization Workshop**
3/7/2019-5/7/2019	Seoul, South Korea	**NANO KOREA 2019**
3/7/2019	Seoul, South Korea	**Korea-Austria Nano Innovation Workshop**

Acknowledgement

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Korea Nano Technology Research Society (KoNTRS, South Korea)

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National Nanotechnology Center (NANOTEC, Thailand)

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