



ANNUAL REPORT 2021

Asia Nanotechnology Leaders

Shaping the Future of Science & Technology for Socio-Economic Well-Being

 Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

 **THE ENERGY AND
RESOURCES INSTITUTE**
Creating Innovative Solutions for a Sustainable Future


**Iran Nanotechnology
Innovation Council (INIC)**

 **AIST**

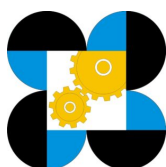




 **KoNTRS**
Korea Nanotechnology Research Society

 **NANOMALAYSIA™**

 **MOSTI**
KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION




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CONTENTS

Annual Report 2021

Preface	ii
About Asia Nano Forum	1
Mission & Objectives	1
Working Groups	2
Member Organizations	3
Office Bearers (2020-2021)	4
Executive Committee	5
Former Presidents	6
Other Founding Members	7
Working Group Report	8
Standardization	8
User-Facility Network	11
Nano Safety and Risk Management	14
Commercialization	21
ANF Summit Report	23
Country Report	32
Report from India	32
Report from Iran	37
Report from Japan	43
Report from Korea	46
Report from Malaysia	49
Report from The Philippines	58
Report from Taiwan	60
Report from Thailand	65
Acknowledgements	69

Preface

It is still now a time of uncertainty and also a time of change since the outbreak of world-wide COVID-19 pandemic in late December 2019. Like so many of online events, the flagship ANF Summit and conjunctive events were also held virtually for two consecutive years. However, we have pretty active members and network partners who have worked together to meet all challenges and reach the set goals. In this report, we are grateful for seeing the success and much about country's progress with nanotechnology in our member countries as well.

As a network organization, ANF has been promoting responsible development of nanotechnology by encouraging international collaboration toward common objectives in various areas or issues such as standardization, user-facility, nanosafety and commercialization that are also addressed by four working groups respectively. For standardization, the ongoing project "*Nanotechnologies – Performance evaluation of nanosuspensions containing clay nanoplates for quorum quenching*" at WG5 (Products and Applications) led by ANF, the Liaison member of ISO/TC 229, was approved for a new project registered as ISO TS 4971 last April. For nanosafety, a concept paper of "*International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano)*" was also released last June by the network collaboration between ANF and Nanosafety Cluster (NSC/EU). An overall review of Working Groups in this report would give more examples.

Having done our part in the two-year term, I would like to thank all members for their continued support and also expressed sincere thanks to my teammates including two Vice Presidents Dr. Yasuo Koide and Dr. Wannee Chinsirikul, two Secretaries Dr. Annabelle V. Briones and Dr. Jason Chang, and Treasurer Dr. Rezal Khairi Ahmad. They have been extremely helpful to keep ANF moving forward during this difficult time under COVID-19 pandemic. Now, it's a new beginning – the year of 2022 and our new term of ANF administration led by Dr. Wannee, Thailand. We are looking forward to more inspiring and successful accomplishments into the new year. Thank you.



Ting-Kuo Lee
President, Asia Nano Forum

About Asia Nano Forum

■ Mission & Objectives

Asia Nano Forum (ANF) is a network organization, founded in May 2004 and now a registered society in Singapore, known as Asia Nano Forum Society, since October 2007.

Mission

The mission of the ANF is to promote responsible development of nanotechnology that will benefit each member on education, economy, and environment by fostering international network collaboration.

Objectives

- 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 joint investment in and 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

About Asia Nano Forum

■ 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.

Coordinators:

Dr. Tsing-Tang SONG (ITRI, Taiwan)

Prof. Ali BEITOLLAHI (INIC, Iran)

User-Facility Network

The purpose of the User-Facility Network working group is to advance exchange and partnership activities of professional engineers/researchers in academia and industry.

Coordinator:

Dr. Yasuo KOIDE (NIMS, Japan)

Nano Safety and 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 translation of nano research to the marketplace.

To provide a coordinated response for community concerns and engagement on nanotechnology safety and risk management issues.

Coordinators:

Dr. Wannee CHINSIRIKUL (NANOTEC, Thailand)

Dr. Paul WRIGHT (RMIT, Australia)

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.

Coordinators:

Dr. Rezal Khairi AHMAD (NanoMalaysia, Malaysia)

Mr. Alexander POGANY (BMK, Austria)

Dr. Jun'ichi SONE (JST, Japan)

About Asia Nano Forum

■ Member Organizations

ANF has currently 13 organization members from 10 countries including Austria, India, Iran, Japan, Korea, Malaysia, The Philippines, Taiwan, Thailand, and Vietnam.

Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), Austria

The Energy and Resources Institute (TERI), India

Iran Nanotechnology Innovation Council (INIC), Iran

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

Japan Science and Technology Agency (JST), Japan

National Institute for Materials Science (NIMS), Japan

Korea Nano Technology Research Society (KoNTRS), Korea

NanoMalaysia Berhad, Malaysia

National Nanotechnology Centre (NNC), Malaysia

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

Institute of Physics, Academia Sinica, Taiwan

National Nanotechnology Center (NANOTEC), Thailand

Vietnam Academy of Science and Technology (VAST), Vietnam

About Asia Nano Forum

■ Office Bearers (2020-2021)



Ting-Kuo LEE
President
NSYSU, Taiwan



Yasuo KOIDE
Vice President
NIMS, Japan



Wannee CHINSIRIKUL
Vice President
NANOTEC, Thailand



Rezal Khairi AHMAD
Treasurer
NanoMalaysia Berhad



Jason CHANG
Secretary
Academia Sinica, Taiwan



Annabelle V. BRIONES
Secretary
DOST-ITDI, The Philippines

About Asia Nano Forum

Executive Committee

Alexander POGÁNY

BMK, Austria

Rezal Khairi AHMAD

NanoMalaysia, Malaysia

Pushplata SINGH

TERI, India

Ruslinda RAHIM

NNC, Malaysia

Ali BEITOLLAHI

INIC, Iran

Annabelle V. BRIONES

DOST-ITDI, Philippines

Toshihiko KANAYAMA

AIST, Japan

Maw-Kuen WU

Academia Sinica, Taiwan

Junichi SONE

JST, Japan

Wanee CHINSIRIKUL

NANOTEC, Thailand

Yasuo KOIDE

NIMS, Japan

Tran Dai LAM

VAST, Vietnam

Byung-ki CHEONG

KoNTRS, Korea

(by alphabetical order of region/organization, one from each organization)

About Asia Nano Forum

■ Former Presidents



K. TANAKA
Founding Chairman
JST & AIST, Japan



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



Hak Min KIM
President 2010-2011
KAIST, Korea



Teruo KISHI
President 2012-2013
ISMA, Japan



Sirirung SONGSIVILAI
President 2014-2015
NANOTEC, Thailand



Ramam AKKIPEDDI
President 2016-2017
IMRE-A*STAR, Singapore



Toshihiko KANAYAMA
President 2018-2019
AIST, Japan

About Asia Nano Forum

■ Other Founding Members



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



Khiangwee LIM
Founding Vice President 2007-2010
NRF, Singapore



**Venkatesh Rao
AIYAGARI**
India



Jane NIALL
Australia



Hong Khoi PHAN
Vietnam



Wiwut TANTHAPANICHAKOON
Thailand



Halimaton HAMDAN
Malaysia

Working Group Report

■ Standardization

Coordinators:

Dr. Tsing-Tang Song (ITRI, Taiwan)

Prof. Ali Beitollahi (INIC, Iran)

The objective of the standardization working group is to promote and coordinate standardization nanotechnology concepts and measurements. Through participation in the ISO/TC 229 and IEC/TC 113, ANF would be able to maintain close links with the latest development of nanotechnology standardization. It is expected to further facilitate harmonized standards among ANF members. We also encourage and promote common interest and benefits in mutual recognition on nanoproducts certification. The following are brief reports on events related to nanotechnology standards and status of ANF in ISO/TC 229 as well as IEC/TC 113.

Activities in IEC/TC 113

In IEC/TC 113 WG3 (Performance Assessment), two projects, including IEC TS 62607-4-4 and IEC TS 62844, have been proposed by ANF. The project leader is Dr. Bin-Cheng Yao (Taiwan) who is also ANF's liaison officer in IEC/TC 113. IEC TS 62607-4-4 entitled "*Nanomanufacturing - Key control characteristics - Part 4-4: Nano-enabled electrical energy storage - Thermal characterization of nanomaterials, nail penetration method*" provides a measurement method for thermal runaway quality level test for nano-enabled energy storage devices. IEC TS 62844 entitled "*Guidelines for quality and risk assessment for nano-enabled electrotechnical products*" provides generic guidelines on the implementation of quality and EHS assessment for nanoproducts. These two standards have been published by IEC in 2016.

Activities in ISO/TC 229

In ISO/TC 229 WG5 (Products and Applications), there is an ongoing project entitled "*Nanotechnologies – Performance evaluation of nanosuspensions containing clay nanoplates for quorum quenching*" that was proposed by Dr. Tsing-Tang Song (Taiwan) on behalf of ANF in 2019. The clay nanoplate suspension in water is designed to inhibit the growth of pathogenic bacteria to protect crops from diseases. It is expected to create substantial value and a reduction of chemical usage in crop production. After a result of voting on New Work Item Proposal in April 2021, ISO/TC 229 approved that this project is registered as ISO AWI TS 4971. Seven members from Canada, Iran, Japan, Korea, Mexico, Singapore, and the US nominated experts to participate in this project. The liaison officer of ANF in ISO/TC 229 is Prof. Ali Beitollahi from Iran. Since 2020, Iran has led developing three published ISO standards and two ongoing standards in ISO/TC 229.

Mutual Collaboration between nanoMark and NanoVerify

The program of interlaboratory comparison was initiated by Nano Common Lab. ITRI (Taiwan) and Failure Analysis Lab, MIMOS Semiconductor (Malaysia) in 2017. The result of comparison has served as the harmonization of measurement capability for nanoparticle size between these two laboratories and a foundation for cooperation in products certification between Taiwan's nanoMark and Malaysia's NanoVerify. Both mark systems were open for foreign company applications in 2018. JM Material Technology from Taiwan is the first mutual recognition certified company, which produces nano-TiO₂ and silver nanocomposite aqueous solution coating.

Nanotechnology Standards in ANF

There are new nanotechnology standards in 2021 published with corresponding international standards (ISO) or based on researches, studies and national consensus.

Code	Title	National Standards
IS 17567: Part 1: 2021	ISOTS 19807-1:2019 Nanotechnologies Magnetic nanomaterials Part 1: Specification of characteristics and measurements for magnetic nanosuspensions	India
INSO 8706	Nanotechnologies - Nanoporous materials - Measurement and determination of pore size distribution and porosity of solid materials by gas adsorption - Analysis of macropores, mesopores, and micropores (*Based on researches, studies and national consensus)	Iran
INSO 6254	Nanotechnologies - Carbon nanotube suspensions - Determination of characteristics and measurement methods	
INSO 6302	Nanotechnologies - Antibacterial silver nanoparticles - Determination of characteristics and measurement methods	
INSO 6340	Nanotechnologies - Guidelines for the management and disposal of waste from the manufacturing and processing of manufactured nano-objects (*Based on researches, studies and national consensus)	
INSO 6540	Nanotechnologies - Testing the photocatalytic activity of nanoparticles for NADH oxidation	
INSO 22778	Nanotechnologies - Guidance on detection and identification of nano - objects in complex matrices	
INSO 22779-1	Nanotechnologies - Clay nanomaterials - Part 1: Specification of characteristics and measurement methods for layered clay nanomaterials	

PNS ISO/TR 19733:2021	Nanotechnologies - Matrix of properties and measurement techniques for graphene and related two-dimensional (2D) materials	The Philippines
PNS ISO/TS 10867:2021	Nanotechnologies - Characterization of single-wall carbon nanotubes using near infrared photoluminescence spectroscopy	
PNS ISO/TS 11308:2021	Nanotechnologies - Characterization of carbon nanotube samples using thermogravimetric analysis	
PNS ISO/TS 14101:2021	Surface characterization of gold nanoparticles for nanomaterial specific toxicity screening: FT-IR method	
PNS ISO/TS 16550:2021	Nanotechnologies - Determination of silver nanoparticles potency by release of muramic acid from <i>Staphylococcus aureus</i>	

Working Group Report

■ User-Facility Network

Coordinator:

Dr. Yasuo Koide (NIMS, Japan)

The 2021 activities of User-Facility Network working group (UFN-WG)

Yasuo Koide (NIMS)

1. Engineers/researchers exchange program and workshop

The User-Facility Network working group (UFN-WG) was newly launched at January, 2020. The purpose is to accelerate exchange and partnership activities of user-facility networks and professional engineers and researchers in industry and academia. The first plan in 2021 is a trial attempt for mutual exchange for 2~4 weeks between engineers/researchers in NIMS (Japan) and Nanotech (Thailand) where the host research institute arranges the training and practice programs and accommodation. Unfortunately, the plan has been stopped now due to the CORONA virus pandemic. The second plan was to hold the workshop on “User-Facility Network in Asia” in nanotech 2022 which was held on Jan. 26-28, 2022, in Tokyo as explained in the next section.

2. Report on 2022 Symposium on User-Facility Network in Asia

The purpose is to share information on user-facility activities and advanced nanofab, nanobio, and nano-characterization technologies in Asia. This first symposium was held on January 27 (Thu.) 2022 and was the hybrid online/onsite event on Day 2, nanotech 2022, Tokyo. The venue was the room 802, Conference Tower at Tokyo Big Sight. The program was as follows, and 8 speakers in 6 different countries, Korea, Japan, Thailand, Malaysia, Austria, and Taiwan, in ANF members presented.

-
- 13:00 Greeting
Y. Koide
 - 13:05 “Introduction to the National Nanofab Center (NNFC)”
J-W. Lee, National NanoFab Center (NNFC), Korea
 - 13:30 “Overviews of Nanotechnology Platform Japan”
Y. Koide, National Institute for Materials Science (NIMS), Japan
 - 13:55 “Introduction of Advanced Research Infrastructure for Materials and Nanotechnology in Japan”
J. Sone, Japan Science and Technology Agency (JST), Japan
 - 14:20 “Nanotechnology Research Capabilities and Network in Thailand”
W. Chinsirikul, NANOTEC, Thailand
 - Break (15 min) –
 - 15:00 “Malaysia Nanotechnology Laboratory Network”
R. A. Rahim, Ministry of Science, Technology and Innovation (MOSTI), Malaysia

- 15:25 “*Open research facilities of TIA Japan*”
T. Tada, National Institute of Advanced Industrial Science and Technology (AIST), Japan
- 15:50 “*EVG’s Heterogeneous Integration Competence Center (HICC) – Winning in the age of disruption*”
T. Uhrmann, EV Group GmbH, Austria
- 16:15 “*Nano-fabrication technology and facility in Taiwan*”
T-T. Miao, Academia Sinica, Taiwan
- 16:40 Concluding
D. Fujita

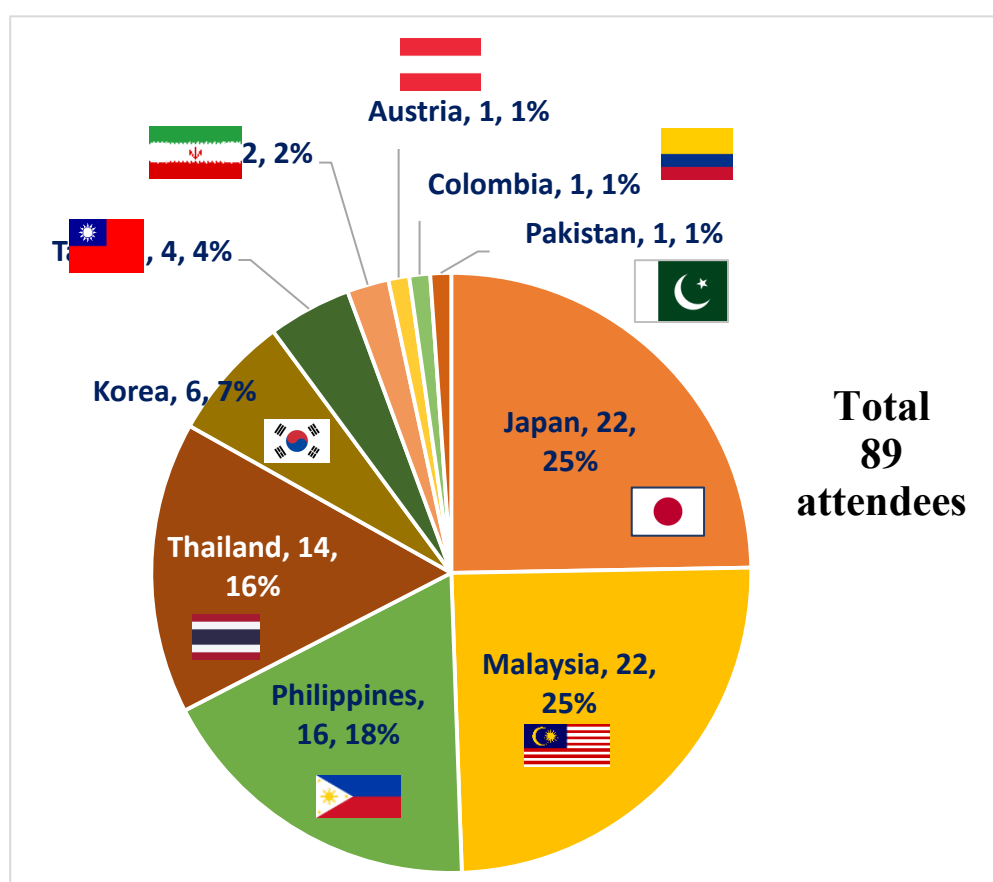


Fig. 1 Distribution of attendee’s countries and numbers.

Figure 1 shows numbers of attendees and percentage of countries which join the symposium by online. As much as 89 people attended the symposium, and the registration was made by 125 people. Figure 2 shows photos of first and latter half of sessions in the symposium. Dr. Koide made greeting with an objective explanation. Dr. J-W. Lee, President of NNFC, comprehensively explained Korea Si-based nanofabrication technology in government project. Dr. Koide, NIMS, reviewed Nanotechnology Platform Japan (NPJ) project for ten years from 2012 to 2021, and Dr. Sone, JST, summarized the next ten-year user-facility &

data project in Japan. Dr. Chinsirikul, Director of NANOTEC Thailand, summarized the NANOTEC reviews and user-facility status in Thailand. Dr. Rahim, MOSTI Malesia, presented summarizing nanotechnology project and the plan for user-facility network project in Malesia. Dr. Tada, AIST Japan, explained the open research facility network in TIA Japan. Dr. Uhrmann, EV Group GmbH Austria, summarized the heterogeneous integration technology in Si and other semiconductors with his company's concept. Dr. Miao, Academia Sinica Taiwan, summarized the nano-fabrication technology and facility in Taiwan. Finally, Dr. Fujita, Director of Advanced Characterization Nanotechnology PF in NPJ project, made the concluding remark. The fruitful discussion along Q&A were made by speakers and attending audiences.



(a)



(b)



(c)

Fig. 2 Symposium photos of (a) first half session and (b) and (c) latter half session where the symposium was held on Jan 27, 2022, at room 802 in Tokyo Big Site.

Working Group Report

Nano Safety and Risk Management

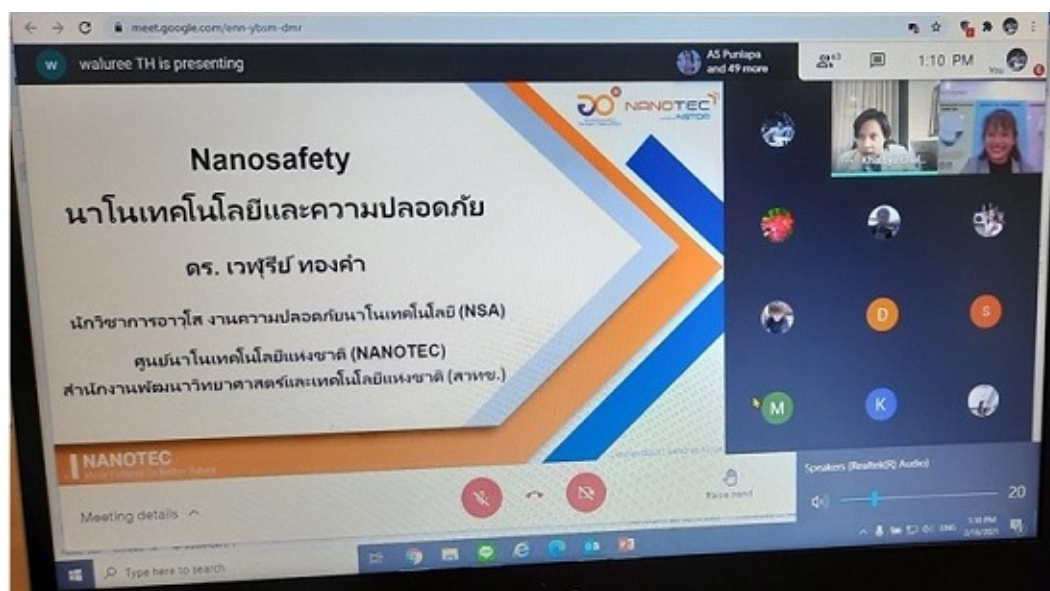
Coordinators:

Dr. Wannee Chinsirikul (NANOTEC, Thailand)

Assoc. Prof. Paul Wright (RMIT University, Australia)

1. NANOTEC – KMITL Nanosafety online workshop

On 16 February 2021, nanotechnology and engineered nanomaterials have created a tremendous growth potential for a large number of industry sectors from electronics, construction, coating, to food and medical technologies. As with all technology development comes concerns for the possible effects on human health, safety, and the environment. Promoting public awareness of nanosafety necessary for building public confidence and sustainability of technology development. For the past few years, National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA) and the College of Nanotechnology at King Mongkut's Institute of Technology Ladkrabang (KMITL) have been organizing nanosafety workshops to help build students and faculty understand of issues related to nanotechnology. Students attending the workshop will be graded according to their participation and test results. Due to the COVID 19 pandemic situation, the workshop was conducted online.



Nanosafety on-line workshop

2. Webinar Forum on Nanosafety: From Lab to Society

On 24 March 2021, NANOTEC (Thailand) and National Nanotechnology Center (NNC) in Malaysia with support from Asia Nano Forum (ANF) organized the webinar Forum on Nanosafety: From Lab to Society. With the growing use of nanomaterials there is of course

the question of health security and uncertainties. For this reason, reassuring the public on nanosafety becomes a priority. The public should be able to know exactly which product uses nanotechnology and what are the risks related to health in both terms of hazards and exposures. The forum served as a venue to address the potential issues, knowledge exchange, and to promote sustainability of nanotechnology development by implementing awareness campaign related to potential environmental, health, and safety (EHS) impact of nanotechnology. The forum was divided into 3 sessions:

- 1) Technical/Research
- 2) Awareness of Nanosafety
- 3) Panel discussion on Implication and impact of nanosafety towards society



Webinar Forum on Nanosafety: From Lab to Society

3. Webinar Forum on Knowledge of Registration Entrepreneur for Cosmetics & NanoQ

On 26 March 2021, NANOTEC and the Nanosafety Network for Industry organized a webinar on **"Registration 101: Cosmetic and NanoQ"**. The objective of this seminar was to disseminate knowledge and understanding related to the procedure of cosmetics registration and NanoQ label request for entrepreneurs in the cosmetic industry including stakeholders using nanomaterials in the production process and to promote entrepreneurs realizing the importance of products containing nanomaterials and strengthen the confidence of consumers in the quality of nanoproducts.

The seminar was focusing on 3 topics as below:

- 1) Cosmetics Registration
- 2) The Importance of Nanoscale Dimension Measurement

3) How to request NanoQ Label

Speakers included Mrs. Parinda Techasirinukul, Pharmacist Cosmetic Control Division which was representative from Thai Food and Drug Administration (FDA), Dr. Tanakorn Osotchan, Chairman of NanoQ, Nanotechnology Association of Thailand and acting deputy executive director, NANOTEC, and Dr. Jitapa Sumranjit, Senior Researcher at Nanocharacterization Research Team, NANOTEC. Attendees for the webinar included participants from the nine Nanosafety Network for Industry members partners, academia, research agencies, and private sectors groups.



Webinar Forum on Registration 101: Cosmetic and NanoQ

4. Concept paper of “International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano)”

NANOTEC has been invited to participate as one of the contributors for a concept paper “International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano)” to emphasis the ecosystem for global collaboration in selected fields of action, enabling “collaboration without borders” within joint projects, joint funding initiatives, and any further way of cooperation. The goal of this initiative would be to establish a collaboration between the European NanoSafety Cluster/ Community and interested countries from other continents in order to expand the common knowledge base for (nano) materials of regulatory significance and to support the needs of various stakeholders including regulatory bodies and industry.

On 21st June 2021, A concept paper “International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano)” was published on ZENEDO website and will be delivered to the European Commission and to each of the participating countries’ government. The link of concept paper is <http://doi.org/10.5281/zenodo.5004929>



INISS-nano

5. The “Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization”

On 5 August 2021, Dr. Wannee Chinsirikul, NANOTEC and Assoc. Prof. Paul Wright, RMIT University, Australia which are the working group’s coordinators of ANF Working Group on Nano Safety and Risk Management organized the “Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization”.

This activity gave an opportunity to exchange experiences in areas related to Nanosafety ISO/TC229 and lead to cooperation in the region.



The “Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization”

6. The 3rd virtual INISS-nano meeting

On 12 November 2021, Dr. Pavadee Aungkavattana, NANOTEC Deputy Executive Director and Dr. Waluree Thongkam, senior researcher, Nano-Safety Alliance Section attended the 3rd virtual INISS-nano meeting. The participants discussed the implementation of a concept paper “International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano)” which was published on the ZENEDO website on 21st June 2021 (<http://doi.org/10.5281/zenodo.5004929>).

This concept paper prepared the ecosystem for global collaboration in selected fields of action which consist of 4 pillars:

- 1) Harmonization pillar:
 - a) Standardization efforts
 - b) Transfer of science into policy, regulation
- 2) Support industrial understanding
- 3) Sharing Facilitate/infrastructures (e.g. laboratories, human resources, skills & knowledge, capacity building, etc.)
- 4) Ethical aspects

Based on the idea of a “network of networks”, the “international network initiative on safe and sustainable nanotechnology” (INISS-nano) was formed, aiming to bring together science, industry and government from partners all over the world, not duplicating structures but connecting with them (e.g. European NanoSafety Cluster, Asia Nano Forum, European Commission, etc.)

This initiative focused on the collaboration in different fields pertaining to nanotechnology research in general and nano-safety research which include collaboration in terms of training, standardization efforts, test-guidelines development, metrology, commercialization, ethical aspects, sustainability, and joint research, supporting governance, and regulatory guidance.



The 3rd virtual INISS-nano meeting

7. NanoforAgri-2021: Technology readiness and overcoming regulatory barriers to implement nanotechnology-enabled agriculture for sustainable future

On 9 December 2021, Dr. Waluree Thongkam, Senior Technical Officer, Nano -Safety Alliance Section, NANOTEC was invited to be a speaker on the topic of “Overview of recent Nanosafety activities for industry in Thailand” in Session IV: Regulatory Aspects of Nanotechnology of the NANOFORAGRI 2021 Conference. The conference was organized in the theme of “Technology readiness and overcoming regulatory barriers to implement nanotechnology – enabled agriculture for sustainable future”.

The lecture on the topic “Overview of recent Nanosafety activities for industry in Thailand” can create awareness of Nanosafety in the industrial sectors of Thailand as well as strengthen cooperation with foreign alliance networks. The conference was held at Gurugram, India, along with an online platform and was attended by speakers from many countries, such as Italy, France, the Netherlands, etc.



NanoforAgri-2021

8. The Nanosafety session at NanoThailand 2021

On 16 December 2021, NANOTEC organized the Nanosafety session on the topic "Nanotechnology: Bioactive compound and safety testing model" via an online platform.

This session consisted of sharing knowledge and experiences in the topic related to the safety of bioactive compounds evaluated in various types of testing models. The seminar was held in collaboration with international experts from Vietnam, Spain, and the Philippines, which Dr. Waluree Thongkam, Senior Technical Officer, Nano-Safety Alliance Section of NANOTEC was a moderator. This seminar was intended to strengthen the collaboration on nano-safety between international alliances.



The Nanosafety session at NanoThailand 2021

Working Group Report

Commercialization

Coordinators:

Dr. Rezal Khairi Ahmad (NanoMalaysia, Malaysia)

Mr. Alexander Pogany (BMVI, Austria)

Dr. Junichi Sone (JST, Japan)



Asia Nano Forum Commercialization Workshop ANF

- ☐ Virtual Platform: ZOOM
- ☐ Date: Friday, 6 August 2021
- ☐ Time: 9am to 12.30pm (Bangkok Time)
- ☐ Presentation Duration: 10 mins + 5 mins (Q&A)
- ☐ Presentation Content: Company/Organization's nanotechnology or related products/solutions/services

- 9.00am: Welcoming Remarks by **Dr Pavadee Aungkavattana**, Deputy Executive Director of NANOTEC (Thailand)
- 9.10am: Opening Remarks by **Dr Rezal Khairi Ahmad**, ANF Treasurer and ANF CWG Coordinator and Workshop Moderator (Malaysia)
- 9.15am: Presentations
 - PAC Klean Air Conditioning Cleaner and Sanitizer - **Ms Atchara Poomee**, (Managing Director) PAC Corporation Co.,Ltd (Thailand)
 - Nano Disinfectant - **Mr. Nattiruj Rattanasarunwit**, (Assistant Managing Director) Bioinnotech Co.,Ltd (Thailand)
 - iNano Your Innovative Nanotechnology Solutions Partner - **Prof. Dr. Gil Nonato C. Santos**, Nano Coat Anti Heat Solution (The Philippines)
 - Thermal Insulation Materials for Application Temperatures from -235°C to Beyond 2000°C - **Dr Rudder Wu**, (Founder and CTO) Thermalytica Inc (Japan)
 - IP Commercialisation Strategy - **Mr Raguraman Gurusamy**, (CEO) Global IP Ventures (Malaysia)
- Coffee Break: 10 minutes
 - The Formulation of Cosmetic Products Using Nanotechnology and Nanophytochemicals - **Ms Savina Kaharuddin**, (CEO) VNI Scientific (Malaysia)
 - Nanofluid For Cooling - **Bernard Sagaiyara**, (Director) Blue Snow Energy (Malaysia)
 - Nanotech & Clean Energy Solution for Cleaner Future - **Aryan Aviraj Mishra**, (Founder) Aavalor Green Energy (India)
 - Nano Cosmetics in Indonesia - **Aulia Rifada**, (CEO) Natura Nanotech Indonesia Co.,Ltd (Indonesia)
 - Nanobubble in Indonesia - **Hardi Junaedi**, (CEO) Nanobubble Karya Indonesia Co.,Ltd (Indonesia)
- 11.55am: Closing Remark by **Dr Rezal Khairi Ahmad**

The Asia Nano Forum (ANF) Workshop on Commercialisation 2021 was organised during the 18th Asian Nano Forum Summit 2021 (ANFoS2021) on 6 August 2021. The Workshop was organised by NanoMalaysia Berhad, led by Dr Rezal Khairi Ahmad, in collaboration with the ANF Working group on Commercialisation and NANOTEC Thailand as the host of ANFoS2021.

Workshops on Commercialisation have been held every year since the Commercialisation Working Group (CWG) formation in Singapore (ANFoS 2016). The Commercialisation Working Group aims to promote cross-border commercialisation activities facilitated by Asia Nano Forum (ANF) platform at strategy and implementation levels. The Commercialisation Working Group also acts as a convergence and exchange platform facilitating cross-border technology transfer between businesses, research institutes and academia.

Similarly to 2020, the 2021 Workshop was conducted online via Zoom. There were over 30 participants who joined the Workshop.

The topics and speakers presented during the Workshop were:

1. *PAC Klean Air Conditioning Cleaner and Sanitizer*
 - Ms Atchara Poomee, (Managing Director) PAC Corporation Co.,Ltd (Thailand)
2. *Nano Disinfectant*
 - Mr. Nattiruj Rattanasarunwit, (Assistant Managing Director) Bioinnotech Co.,Ltd (Thailand)
3. *iNano Your Innovative Nanotechnology Solutions Partner*
 - Prof. Dr. Gil Nonato C. Santos, Nano Coat Anti Heat Solution (The Philippines)
4. *Thermal Insulation Materials for Application Temperatures from -235°C to Beyond 2000°C*
 - Dr Rudder Wu, (Founder and CTO) Thermalytica Inc (Japan)
5. *IP Commercialisation Strategy*
 - Mr Raguraman Gurusamy, (CEO) Global IP Ventures (Malaysia)
6. *The Formulation of Cosmetic Products Using Nanotechnology and Nanophytochemicals*
 - Ms Savina Kaharuddin, (CEO) VNI Scientific (Malaysia)
7. *Nanofluid For Cooling*
 - Bernard Sagaiyaraj, (Director) Blue Snow Energy (Malaysia)
8. *Nanotech & Clean Energy Solution for Cleaner Future*
 - Aryan Aviraj Mishra, (Founder) Aavalor Green Energy (India)
9. *Nano Cosmetics in Indonesia*
 - Aulia Rifada, (CEO) Natura Nanotech Indonesia Co.,Ltd (Indonesia)
10. *Nanobubble in Indonesia*
 - Hardi Junaedi, (CEO) Nanobubble Karya Indonesia Co.,Ltd (Indonesia)

The Workshop allowed participants to discuss the policy, challenges and solutions for nanotechnology commercialisation.

ANF Summit Report

The 18th Asia Nano Forum Summit (The 14th Annual General Meeting)

in conjunction with

*"Nanosafety Forum on Country Experiences and Predictive Model
Development for Safety Guidelines and Standardization" and
"Asia Nano Forum Commercialization Workshop"*

Summary of the 18th ANF Summit

Due to COVID-19 pandemic, ANF members held the online Summit meeting at 13:10 Bangkok time (ICT, GMT+7:00) on 6th August 2021 via the Cisco Webex.

I. Opening Remarks

Dr. Ting-Kuo Lee, President of ANF, thanked Dr. Wannee Chinsirikul and her NANOTEC team for making this ANF Summit possible and extended a warm welcome to all representatives attending this year's online meeting. He also expressed thanks to his teammates including two Vice Presidents Dr. Yasuo Koide and Dr. Wannee Chinsirikul, two Secretaries Dr. Annabelle V. Briones and Dr. Jason Chang, and Treasurer Dr. Rezal Khairi Ahmad. They have been helping make decisions and get through the difficult time under COVID-19 pandemic. Dr. Lee mentioned that there will be a new term of ANF administration for the years of 2022-2023 after today's meeting. And without expenses on physical activities under pandemic, there are a lot of savings in the last two years. He wished more interesting activities in the future could make up all the lost time.

II. Welcome Remarks

On behalf of organizers of ANFoS2021 – NANOTEC, NSTDA and MHESI, Dr. Wannee Chinsirikul expressed her warm welcome to all members in the online 18th Summit under the severe COVID-19 pandemic. She also thanked all speakers, participants, and especially ANF colleagues like Dr. Paul Wright and Mr. Alexander Pogany for "Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization" and Dr. Rezal Khairi Ahmad for "Asia Nano Forum Commercialization Workshop" for making all the activities in conjunction with ANFoS2021 quite successful. Coming to this afternoon session including presentations of Working Groups and INISS-nano followed by the Annual General Meeting today, Dr. Wannee hoped this ANF Summit 2021 would serve as a catalyzed stage of ANF contributions and valuable outcome for nanotechnology community as well as for the society.

III. Working Group Presentations

1. Standardization

Coordinators: Dr. Tsing-Tang SONG (ITRI, Taiwan) and Dr. Ali BEITOLLAHI (INIC, Iran)

- Dr. Song updated members on ANF Standards activities at ISO and IEC. There are three ISO/IEC Nano Standards Led by ANF including IEC TS 62607-4-4:2016 (published), IEC TS 62844:2016 (published) and ISO TS 4971 (ongoing project). With regard to ISO TS 4971 "*Nanotechnologies – Performance evaluation of nanosuspensions containing clay nanoplates for quorum quenching*", it was registered as ISO PWI 4971 in November 2019 and approved for a new project registered ISO TS 4971 on 9 April 2021.
- The latest Liaison status of ANF at ISO/TC229 and IEC/TC113 are Liaison category A / TC level liaison (can propose new work items) at ISO TC 229 (active, 1 ongoing project) and Liaison category C / WG level liaison (cannot propose new work items) at IEC TC 113 (pending cancelation due to inactive), respectively. It's suggested to re-establish active liaison relation with IEC TC 113 to continue ANF's liaison. In addition, Dr. Song also reported on members' latest published standards and activities from Iran, Japan, Korea, Philippines, and India.

2. User-Facility Network

Coordinator: Dr. Yasuo KOIDE (NIMS, Japan)

- Dr. Koide made a brief introduction to the purpose of User-Facility Network and the pilot plan for mutual exchange of researchers / engineers between NIMS (Japan) and NANOTEC (Thailand). He gave some examples of training program established on NIMS's side including materials analysis course, observations course, nanofab course, and nanobio course. Unfortunately, the plan has been still stopped due to COVID-19 pandemic.
- Dr. Koide has also been organizing a workshop on the "2022 Symposium on User-Facility Network in Asia". This hybrid workshop is scheduled to be held online and on-site (Conference Tower, Tokyo Big Sight) on 27th January 2022 during nano tech 2022. In addition to the current tentative speakers including Dr. Wannee Chinsirikul (NANOTEC, Thailand), Dr. J-W Lee (National NanoFab Center, Korea), and Dr. Yasuo Koide and others (NIMS, AIST, and JST of Japan), Dr. Ruslinda Rahim (NNC, Malaysia) and Mr. Alexander Pogany would also like to take this opportunity to present the current progress with the user-facilities in Malaysia and in Europe and Austria, respectively.

3. Nano Safety & Risk Management

Coordinators: Dr. Paul WRIGHT (RMIT, Australia) and Dr. Wannee CHINSIRIKUL (NANOTEC, Thailand)

- On behalf of the Coordinators, Dr. Warulee Thongkam first gave a report on the objectives and previous activities related to Nano Safety & Risk Management, including "*Forum on Nanosafety: From Lab to Society*" organized by NANOTEC (Thailand) and NNC (Malaysia) in March 2021, "*Symposium 8: 3Rs Alternatives for*

Regulatory Testing in the 11th Congress of Toxicology in Developing Countries (CTDC)" in Malaysia in June 2021, and "Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization" organized by NANOTEC and NSTDA (Thailand) this August.

- Dr. Warulee also introduced some ongoing activities, including Development of Nanosafety Network for Industry, Standard Developing Organizations (SDOs), Nanosafety issues collaborated with Department of Industrial Work (DIW) and The Federation of Thai Industries (FTI) of Thailand, and the "7th Thailand International nanotechnology Conference" in December.

4. Commercialization

Coordinators: Dr. Rezal Khairi AHMAD (NanoMalaysia, Malaysia), Mr. Alexander POGANY (BMK, Austria), and Dr. Jun'ichi SONE (JST, Japan)

- Dr. Rezal Ahmad introduced the background of ANF commercialization WG and summarized some activities. ANF Commercialization Working Group was formed at ANF Summit 2015 in Singapore to facilitate realization of economic value of Nanotechnology Research and Development, and organized the pilot workshop in 2017 in association with ANF Summit in Malaysia. There have been a series of workshops at Nanotech 2018 (Japan), ANF Summit 2018 (Taiwan), Nanotech 2019 (Japan), ANF Summit 2019 (The Philippines), Nanotech 2020 (Japan), and ANF Summit 2020 (Austria, online).
- With regard to the online "*Asia Nano Forum Commercialization Workshop*" in conjunction with this ANFoS2021, Dr. Rezal highlighted some presentations by participants from Thailand, The Philippines, Japan, Malaysia, India and Indonesia. Dr. Rezal would also like to plan a possible workshop concurrent with the nano tech 2022 in Japan in the case of a well-controlled pandemic.

IV. The International Network Initiative on Safe and Sustainable Nanotechnologies (INISS-nano)

- As a follow-up of the 4th EU-Asia Dialogue on Nanosafety in conjunction with the ANF Summit 2020 last October, a concept paper of INISS-nano authored by Andreas Falk et al. has been released in June and is open for comments until the 17th August 2021. Also, the 3rd virtual meeting of the INISS-nano-team is scheduled on 1st October.
- Mr. Alexander Pogany, the editor, first made the introductions to background, goals, added value, important action fields, organizational structure, and the next steps. He emphasized this international collaboration is crucial to success in nanotech research, commercialization, and regulation. Further interactions are planned to take place during the 5th EU-Asia Dialogue event in 2022 in Malaysia and the 6th Dialogue event in 2023 in Berlin.
- Following the introduction by Mr. Pogany, a video made by Mr. Andreas Falk from BNN of Austria was then played for further interpretation of the concept paper. Mr. Falk mentioned specially two names of key players in this initiative, Dr. George Katalagarianakis retiring from European Commission and Prof. Ali Beitollahi from Iran.

- With regard to the added value like data sharing and share of common infrastructure, Dr. Wannee suggested there may be a link activity with the User-Facility Network WG Dr. Koide just mentioned in order to synergize the efforts of both two programs or projects to get complementary results.

V. 14th Annual General Meeting (AGM, by Secretariat)

Secretariat's Report

1. Financial Statement of Year 2021

- The balance in all ANF bank accounts including SGD and USD accounts at DBS in Singapore, USD and JPY accounts at Sumitomo Mitsui in Japan has been updated till 30th July this year. We have incomes basically from membership fees and expenditure on service fees for use of registered office address and website maintenance.
- Regarding the membership fees, VAST of Vietnam cannot pay the membership fees for 202 and 2021 due to the complicated financial regulations and would like to skip this Summit. VAST will resume all activities ASAP in 2022 as COVID-19 restrictions ease and they could pay the membership fee. And INIC of Iran has been trying to transfer the membership fee to ANF account in Singapore. However, the payment process of INIC's membership fee has not been successful until now due to some difficulties. As for the membership fees from Korea and Philippines, the payment will be completed very soon.

2. Secretariat activities between October 2020 and July 2021

- Dr. Jason Chang, Secretary of ANF, highlighted Secretariat activities between October 2020 and July 2021, including last online Summit, publications of Newsletter Issue No. 38 and Annual Report 2020, Office-bearer telemeetings in May and July, and website update.

3. Amendment to the ANF Constitution

- According to the ANF bylaw, there should be 4 other Members in the 10-member Committee of administration besides the current 6 Office Bearers. Furthermore, all office bearers, except the Treasurer and Assistant Treasurer may be re-elected to the same or related post for a consecutive term of office.
- However, Treasurer in ANF is more like an independent auditor as the ANF financial management goes with the President. Considering the operational practices, a motion of changing the bylaw "Management and Committee" in the ANF Constitution with an approval was proposed to discussion and then had unanimous support at the Annual General Meeting.
- The differences between content in version 2013 and amended content this year in the ANF Constitution are as follows.

Content, v.2013	Amended Content, v.2021
<p>8.1 The administration of the Society shall be entrusted to a Committee, made up of <u>ten (10)</u> members, to be elected at alternate Annual General Meetings:</p> <p>A President 2 Vice-President 2 Secretary A Treasurer <u>Four Ordinary Committee Members</u></p>	<p>8.1 The administration of the Society shall be entrusted to a Committee, made up of <u>six (6) to ten (10)</u> members, to be elected at alternate Annual General Meetings:</p> <p>A President 2 Vice-President 2 Secretary A Treasurer <u>Up to Four Ordinary Committee Members</u></p>
<p>8.2 Names for the above offices shall be proposed and seconded at the Annual General Meeting and election will follow on a simple majority vote of the members. <u>All office bearers, except the Treasurer and Assistant Treasurer may be re-elected to the same or related post for a consecutive term of office.</u> The term of office of the Committee is two years.</p>	<p>8.2 Names for the above offices shall be proposed and seconded at the Annual General Meeting and election will follow on a simple majority vote of the members. The term of office of the Committee is two years.</p>

4. Election results of ANF Office Bearers for the years of 2022-2023

- In this Summit we're going to elect new ANF Office Bearers for the years of 2022-2023, including ONE President, TWO Vice Presidents, TWO Secretaries, and ONE Treasurer. According to the minutes of Office-bearer telemeeting on 2 July, the online ballots will be cast via an online voting software (i.e. Election Runner) confidentially. The deadline for nomination was 30 July, 2021 and the online ballot was open from 3 August 09:00 to 5 August 17:00 (Bangkok, GMT+7). Announcement of results will be made in the Annual General Meeting on 6 August, 2021.
- Elected ANF Office Bearers for the years of 2022-2023 are as follows.
President (1): Wannee Chinsirikul
Vice Presidents (2): Rezal Khairi Ahmad and Annabelle V. Briones
Secretaries (2): Jason Chang and Pavadee Aungkavattana
Treasurer (1): Shuhei Numazawa
- The transition could probably start pretty soon and all information and paper work should be transferred to the new term of ANF administration by the end of this year.

Current for the years 2020-2021



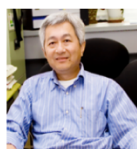
President
Ting-Kuo Lee
NSYSU / Taiwan



Vice President
Yasuo Koide
NIMS / Japan



Vice President
Wanee Chinsirikul
NANOTEC / Thailand



Secretary
Jason Chang
Academia Sinica / Taiwan



Secretary
Annabelle V. Briones
ITDI / Philippines



Treasurer
Rezal Khairi Ahmad
NanoMalaysia / Malaysia

Elected for the years 2022-2023



President
Wanee Chinsirikul
NANOTEC / Thailand



Vice President
Rezal Khairi Ahmad
NanoMalaysia / Malaysia



Vice President
Annabelle V. Briones
ITDI / Philippines



Secretary
Jason Chang
Academia Sinica / Taiwan



Secretary
Pavadee Aungkavattana
NANOTEC / Thailand



Treasurer
Shuhei Numazawa
JST / Japan

5. ANF's participation in nano tech 2022, Japan

ANF Exhibition

- According to the resolution by Office-bearer telemeeting on 2 July, it is suggested that ANF would not join the Hybrid Exhibition for this nano tech 2022.

ANF ExCo Meeting & Commercialization Workshop

- It is suggested that the virtual ExCo Meeting & Commercialization Workshop could be detached from this nano tech 2022 and arranged with a flexible schedule.

2022 ANF Symposium on User-Facility Network in Asia

- Dr. Yasuo Koide gave a briefing on the "2022 Symposium on User-Facility Network in Asia" which is organized by UFN-WG of ANF and will be held online and on-site (Conference Tower, Tokyo Big Sight) on 27th January 2022 during nano tech 2022. As a part of ANF activities, financial support will cover the cost (est. 300,080 JPY) for the symposium.
- Topics would focus on user-facility system and open usage for young scientists or scholars. Speaker nominations are welcome. Current tentative speakers include Dr. Wanee Chinsirikul (Thailand), experts from Korea NanoFab, and Dr. Yasuo Koide and others (Japan).

6. Host country for the ANFoS2022

- On behalf of all member organizations from Japan, Dr. Koide gave a briefing on hosting the next Summit in Japan. The proposed venue would be AIST, Hotel, or International Center at Tsukuba, Japan. Tentative date is Feb. 2 or 3, 2023, just after nano tech 2023. Airport(s) nearby and other travel options are Narita or Haneda International Airport, and Limousine bus transportation services from Tokyo to Tsukuba, respectively. Organizers include Dr. Kanayama, Dr. Aoyagi, and Mr. Kimura (AIST), Dr. Sone and Mr. Numazawa (JST), Dr. Fujita and Dr. Koide (NIMS).
- Considering the Japan Summit planned to take place in 2023, there is a need for proposing an annual meeting (i.e. AGM) for 2022 to comply the constitution.

Through the Summit meeting, members can also review the year's activities and discuss plans for the next year. It would be very welcome if there is any proposal or suggestion for Summit next year.

7. Events in Planning

5th EU-Asia Dialogue on NanoSafety

- The 5th EU-Asia Dialogue on NanoSafety, a physical and virtual event proposed by Dr. Ruslinda A. Rahim of NNC, is scheduled to be held in Putrajaya, Malaysia in June 2022. Mr. Alexander Pogany suggested that there could probably be a back-to-back Summit in 2021 in Malaysia. NanoMalaysia and NNC could collaborate on this tentative idea, Dr. Rezal Khairi Ahmad added.

2nd International Nanotechnology Olympiad

- Because of persistent uncertainty with regard to COVID-19 limitations, the 2nd International Nanotechnology Olympiad (INO) scheduled in January 2021 in Oman and then postponed to 2022, could be delayed again.

VI. Closing Remarks

Dr. Ting-Kuo Lee, President of ANF, thanked members for all their support and wished for everybody's safety and health under the pandemic.

There being no further proposals, the meeting upon motion adjourned at 16:00 Bangkok time (ICT, GMT+7:00).



Online 18th ANF Summit, 6. August, 2021

Programs of conjunctive events**◆ Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization**5th August, 2021**Section I** Country Experiences on Nanosafety Policy and Activities

- Dr. Pushplata Prasad Singh (TERI, India)
- Prof. Ruslinda. A. Rahim (NNC, Malaysia)
- Dr. Persia Ada N. de Yro (ITDI, The Philippines)
- Dr. Jen-Kun Chen (NHRI, Taiwan)
- Dr. Pavadee Aungkavattana (NANOTEC, Thailand)
- Prof. Quang Le Dang (VIIC, Vietnam)
- Mr. Alexander Pogany (BMK, Austria)
- Ms. Mar Gonzalez (France / OECD)

Section II Predictive Model Development for Safety Guidelines and Standardization

- *"Human in vitro models/test systems for nanosafety (including research into toxic mechanisms using the Australian Synchrotron and also metabolomics)"*
Prof. Paul Wright (RMIT University, Australia)
- *"From science to guideline: OECD Perspectives"*
Ms. Mar Gonzalez (Nanosafety Programme / Test Guidelines on Nanomaterials Environment, Health and Safety Division, France/OECD)
- *"ISO TC 229 contributions to measurement and standardization needs for Safe(r)-by-Design predictive models for nanomaterials"*
Dr. Vladimir Murashov (Director's Office National Institute for Occupational Safety, U.S.A.)
- *"3D-tissue models, experiences on guideline development and regulatory purpose"*
by Dr. Silvia Letasiova and Dr. Jan Markus (MatTek Co.,Ltd, Slovak)
- *"How can alternatives to animal testing bring benefit to chemical industry – opportunities and challenges?"*
Dr. Barbara Birk (Research Scientist Experimental Toxicology and Ecology, BASF SE, Germany)
- *"Prediction of Nano Safety in Artificial Intelligence Era"*
Prof. Seokjoo Yoon (Korea Institute of Toxicology, South Korea)
- *"Integration of predictive models in safety testing for nanotechnologies"*
Dr. Sasitorn Aueviriyavit (NANOTEC, Thailand)



Online Nanosafety Forum, 5. August, 2021

◆ Asia Nano Forum Commercialization Workshop

6th August, 2021

- PAC Corporation Co., Ltd. (Thailand)
- Bioinnotech Co.,Ltd (Thailand)
- Nano Coat Anti Heat Solution (The Philippines)
- Thermalytica Inc (Japan)
- Global IP Ventures
- VNI Scientific (Malaysia)
- Blue Snow Energy (Malaysia)
- Aavalor Green Energy (India)
- Nano Natura (Indonesia)
- Nanobubble (Indonesia)

Country Report

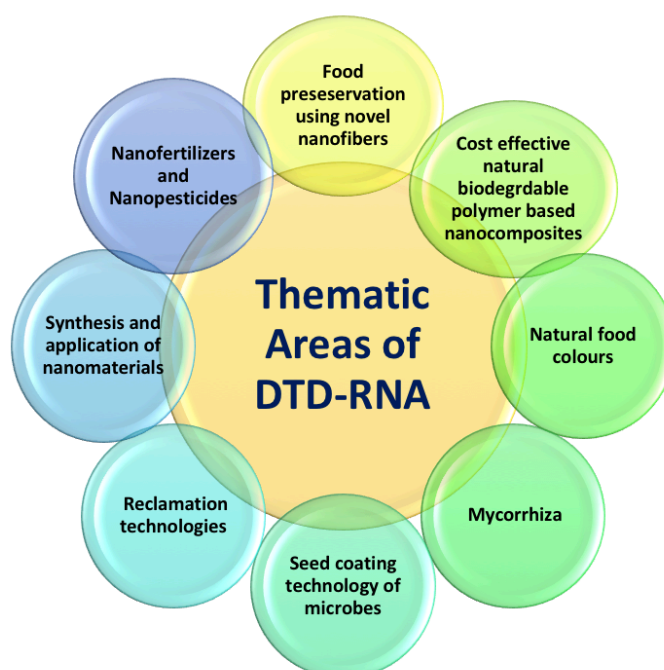
INDIA

TERI, India and Deakin University, Australia are two destinations engaged in intensive research around agriculture, material science, food storage and safety. Innovation in the area of Nanoscience in Deakin University, Australia is also on forefront therefore in 2010, a strategic engagement was established between Deakin University, Australia and TERI, New Delhi India and the centre “TERI-Deakin Nanobiotechnology (TDNBC)” was created at TERI Gram, Gurugram, India.

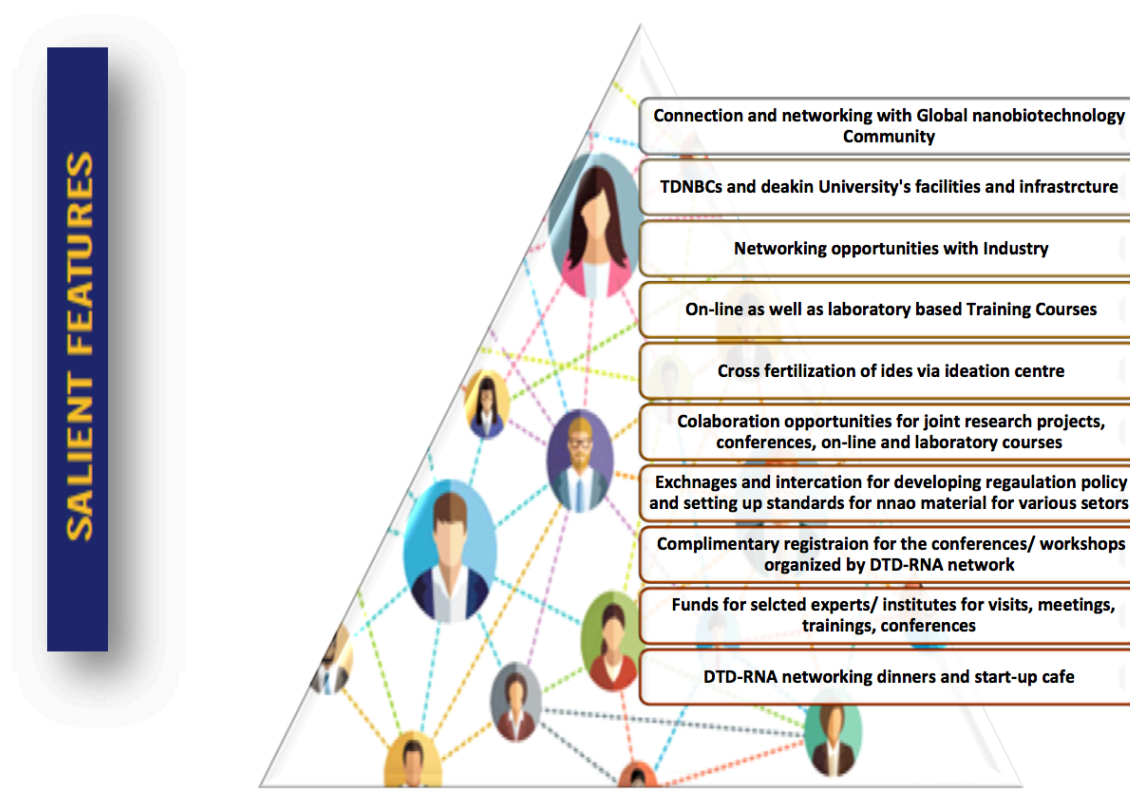
Considering the importance and relevance of joint research platform, TERI-Deakin Nanobiotechnology Centre (TDNBC), Gurugram, India and Deakin University, Australia, in association with Department of Biotechnology, Govt of India has created “DBT -TDNBC - DEAKIN – Research Network Across continents for learning and innovation (DTD-RNA)”.

This is the unique network and has the vision to contribute to a better world through nanotechnology. The Nanotechnology field is one of the fastest growing areas of research and technology. DTD-RNA is dedicated to substantially enhancing research outcomes across continents in this important field by promoting effective collaborations, exposing researchers to alternative and complementary approaches from other fields, encouraging forums for postgraduate students and early career researchers, increasing nanotechnology infrastructure, enhancing awareness of existing infrastructure, creating technology pipelines and IPRs, facilitating technology incubation, transfers and commercialization, connect with industries and promoting international links. DTD-RNA will achieve these goals through its dedication to bringing together all the various groups working in the field of Nanotechnology and related areas across continents.

<https://www.teriin.org/projects/dtd-rna/>



This network is creating joint labs as country hubs and network of research institutions across all continents with the view integrating strengths from TDNBC India and Deakin University, Australia to develop International Centre for Translational Research for research training and education in biological synthesis of Nano materials. Different institutes and countries have been contacted for joining the network for jointly undertaking cutting edge research projects to train young global students, postdoctoral fellows for collaborative research, high end technologies for basic to advanced level of research (joint research publications), to impart education and training (joint research mentorship), workshops and networking (joint workshop/ training).



We publish the quarterly newsletter for activities performed and share it with all the partners and various other groups or individuals to let people know what is happening under the umbrella of DTD-RNA. We have published five issues and conducted multiple events in 2021 under the network's umbrella to impart knowledge in various fields of nanotechnology.

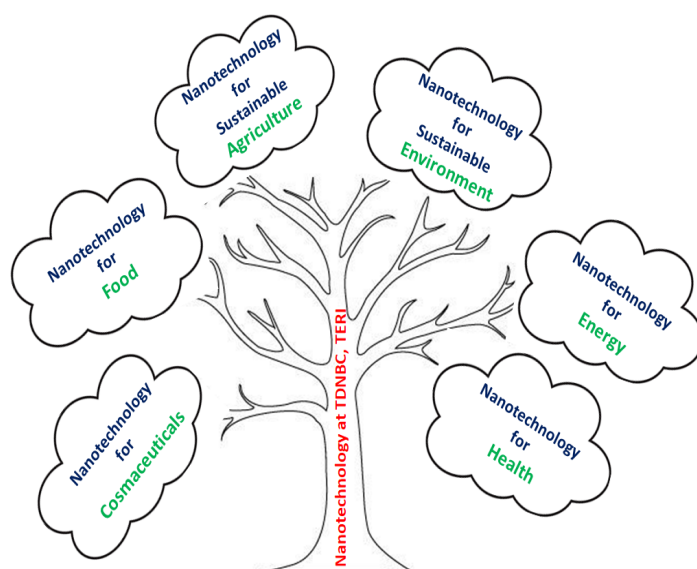
Events conducted in 2021 at TDNBC-TERI:

- Online training on quality control of mycorrhiza
- Webinar on nanosafety/econanotoxicity and regulatory aspects of nanoproducts



- E-Workshop entitled ‘High-End Characterization of Microalgae: Overcoming the Technological Barriers
- E-Workshop on Quality Control of Arbuscular Mycorrhizal Biofertilizers
- Consultative Webinar on Nanostructured Materials in Food Packaging, Preservation and Diagnostics -
- E- Workshop on International Test Guidelines and Methods for Nano safety”
- Webinar on International Test Guidelines And Methods For Nano Safety
- Webinar on Nanostructured Materials (NSMS) In Food Packaging, Preservation And Diagnostics
- Webinar on Next Generation Smart Delivery Systems For Agrochemicals
- Webinar on ‘Waste-Derived Nano-materials: Status, Impact and Future Prospects
- Webinar Series on Waste-Derived Nanomaterials: Part-II - BIO2NANO: BioResources to Sustainable Nanoproducts- Interventions, Current Status & the Future Perspective
- NanoforAgri-2021: Technology readiness and overcoming regulatory barriers to implement nanotechnology-enabled agriculture for sustainable future

Overview of Nanotechnology advancements at TDNBC-TERI



The TERI-Deakin Nano-biotechnology Centre (TDNBC) was established in 2010 by collaboration between India’s biggest think-tank for sustainability, TERI and Australia’s Deakin University. TDNBC integrates the complementary competencies of TERI (in Agricultural Biotechnology) and Deakin University (in Material Sciences). The state-of-the-art green building that now harbors one of the best laboratory facilities in Asia for end-to-end development

of Nanotechnologies for achieving sustainability in Agriculture, Energy and Environment was inaugurated in 2017 by the Prime Ministers of India and Australia. Researchers at the Centre are engaged in carrying out translational research using Next Generation methodologies to create innovative and green solutions. Smart materials that enhance efficacy, reduce chemical usage and GHG emission are being developed at TDNBC for attaining agricultural sustainability and environmental safety.

For the high-quality research work done in the unique area of Agri-nanotechnology, TERI is also highly recognized by the Government of India. DBT, Govt. of India, has awarded TDNBC the first of its kind “Centre of Excellence for Advanced research in agriculture nanotechnology”.

The Centre was also made the nodal agency for drafting the Indian guidelines for regulation of Nano-agriproducts.

The Centre also harbors the mycorrhiza bio-fertilizer research facility, which is also world renowned for developing in-vitro mass production technology for synthesis of biofertilizer based formulations for sustainable agriculture.

Through training and networking programs, TDNBC is also working towards capacity building for Nano-biotechnology research in India as well as many developing/poor countries in Asia and Africa. The Centre provides a hub for 50 PhD students researching under the Deakin India Research Initiative (DIRI).

Nanotechnology in Sustainable Agriculture at TERI	Nanotechnology in Food at TERI	Nanotechnology in Environment at TERI	Nanotechnology in Sustainable Energy at TERI	Nanotechnology in Health at TERI	Nanotechnology in Cosmetic at TERI
<ul style="list-style-type: none"> • Nanofertilizer, nanopesticides & Nanofungicides • Nanomaterials for land reclamation • Nano Nutrient Production & Smart nutrient delivery systems • Nano-seed Technology for Microbes and nanofertilizers • Nanobiosensors for plant disease & Development of Nano barcodes for Arbuscular Mycorrhiza Fungi (AMF) 	<ul style="list-style-type: none"> • Nano-coatings • Nano-packagings films • Nano-sensors for food adulterants • Paper sensors for heavy metals • Nano-food fortification • Spirulina rich food products 	<ul style="list-style-type: none"> • Nano-Safety Assessments • Biogenic Nanomaterials • Degradation of organic pollutants • Sludge Treatment & Bioremediation • Safe microplastic and nanoplastic • Heavy metals detection • Agrowaste management- "Waste to Nanomaterials" 	<ul style="list-style-type: none"> • Green nanomaterials for energy alternatives • Storage devices • Agri-photovoltaics • Energy harvesting capacity of plants • Energy production • Anti-corrosive nanomaterials 	<ul style="list-style-type: none"> • Therapeutics • Bone Engineering • Early disease detection • Endocrine disruptive nanomaterial against Diabetes • Nanomaterials for Omega-3 delivery • Nanomaterials for Antimicrobial treatments 	<ul style="list-style-type: none"> • Marine fungi bioactive for skin treatments • Microfungi based bioactives for skin improvements • Nano-ZnO for skin application • Nanoemulsions for hair growth • Activated nano-charcoal based skin solution • Nano -sprays for tooth decay

Future Development Prospects

In order to improve the prevalent properties of agrochemicals, as well as interactions between agrochemicals and plants can provide vital clues for the development of the translational technology, which can further generate significant benefits to farmers by improving field performance and reducing input expenses, not only in terms of cost, but also by reducing application losses. In the agrochemical sector, there are two main key players, industries and research institutes. Research institutes have robust capabilities to develop “nano-bioactives” or “nano-formulations” and industries typically deliver the product from research laboratories to the market. Moreover, both players can progress effectively and find better solutions for sustainable agriculture with nanotechnology.

We have also been developing next generation agro-nanoproducs, such as nano-fertilizers, nano-pesticides and nano-carriers, with their complete life cycles, toxicity and regulatory assessments for agricultural use and increasing our research and market capabilities for ongoing growth in the agricultural field. There are various methods and technologies that have been developed by TDNBC for increased production, market access, and promoting sustainable farming practices. TDNBC is looking forward to creating collaborative research platforms which will be ready to translate its knowledge base at the grass root level, together in a

coordinated fashion. The collaboration between TDNBC and DTD-RNA networking partners across the world will create solutions in wide range of nanoscience applications for scientific communities.

The TERI-Deakin Nanobiotechnology Research Centre (TDNBC) offers to join in and support the government's vision to promote and assist further in implementing innovation and translational research", at TERI, New Delhi, India.

Country Report

IRAN

National Standard for Waste Management of "Manufactured Nano-objects"

Iran Has developed a Nanotechnology Standard for Disposal and Management of Waste Generated by Production and Processing of Manufactured Nano-objects.

In recent years, nanotechnology has moved from the research laboratory to the manufacturing plant and into consumer products. Manufactured nano-objects (MNOs) can be combined with products to enhance their performance as well as create new properties. In the production process, usage or disposal of these materials might result in the releasing of the MNOs and their interaction with human and environment. The manufacturers of the MNOs and the scientific society do not yet know whether nanomaterials, especially the MNOs, have health risks for laborers, users and environment or not. However, MNOs may have distinct physicochemical properties as a result of their nanoscale formulation. Therefore, they may have risks to human health and environment which are quite different from those caused by non-nano scale materials. So, for management and evaluation of their human and environmental hazards and risks, there must be a special guideline. In the 97th meeting of the National Committee for Nanotechnology Standards, held virtually on 3 February 2021, the "Nanotechnology Standard Guidance for Disposal and Management of Waste Generated by Production and Processing of Nanostructures" was approved and published. It has been compiled via various technical meetings with the participation of experts from universities, Department of Environment (DOE), Municipality, related expert company and the Iran Nanotechnology Innovation Council. These directives have usage for all players in the waste management chain including nanomaterials manufactures, their modifiers as well as waste disposal companies, their delivers and receivers. This standard does not provide guidance for nano-composites' disposal and management, waste derived from consumer products containing nano-objects or waste containing only naturally occurring or incidental nano-objects.



Institute of Standards and Industrial Research of Iran

The 8th international Iran-led standard in nanotechnology has been published

An international standard was developed under the leadership of Iran on the effect of nanomaterials on proteins entitled as " Nanotechnologies — Assessment of protein secondary structure during an interaction with nanomaterials using ultraviolet circular dichroism."



This standard is the 8th international Iran-led standard in the field of nanotechnology that was published after three years of continuous efforts supported by Iran's Nanotechnology Innovation Council (INIC).

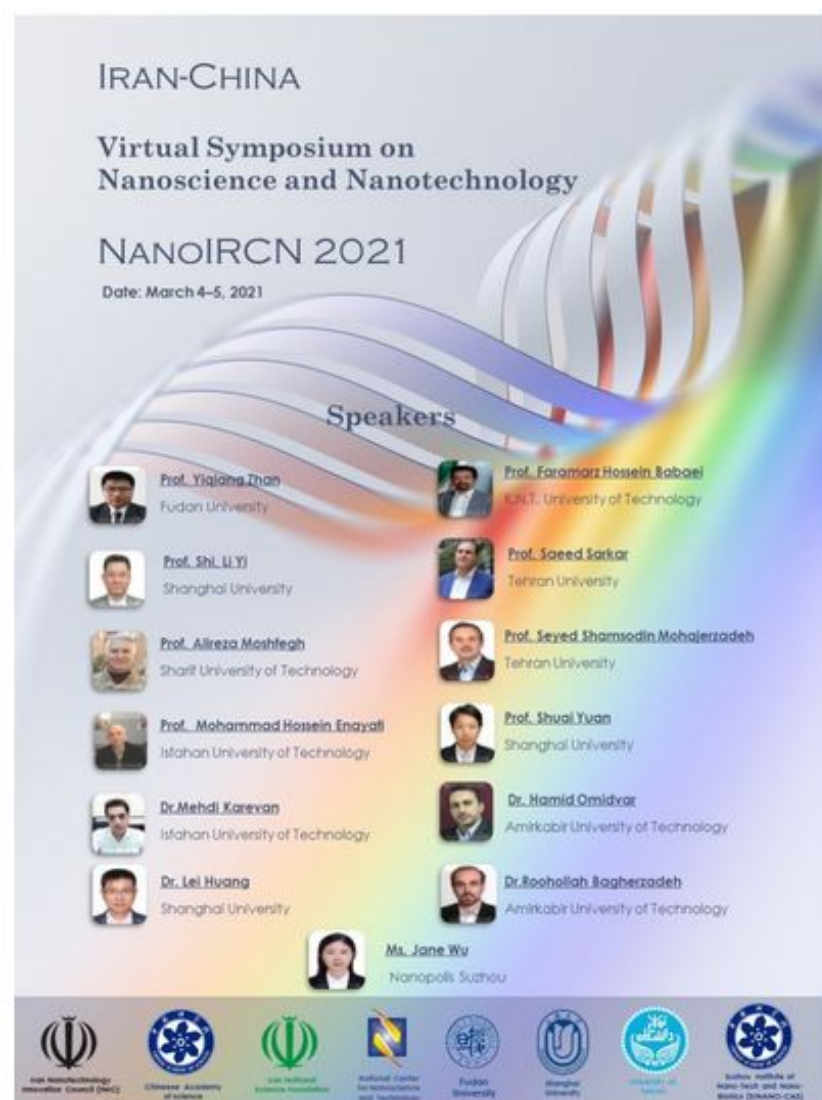
This International Standard specifies measurement protocols and test conditions by which changes in the protein secondary structure during interaction with nanomaterials are determined using ultraviolet circular dichroism.

This standard was proposed to the International Standard Organization (ISO) in 2017 with the support of INIC. After approving Iran's proposal, various and extensive studies were conducted and several expert meetings were held with Iranian as well as foreign experts. The standard was finally published at the official website of the International Standard Organization (www.iso.org) in January, 2021.

Iran-China Virtual Symposium on Nanoscience and Nanotechnology was held on March 3rd and 4th 2021

UT5 consortium composed of the top five Iranian Universities of Technology hold a Virtual Symposium on Nanoscience and Nanotechnology (NanoIRCIN 2021) on March 3rd and 4th 2021 with Chinese institutions.

NanoIRCIN 2021 aimed to promote scientific collaboration between Iranian and Chinese scientists. The topics of this event included Nanomaterials, Nanobiotechnology and Nanomedicine, Nanoelectronics, Nanofabrication and Nanocharacterization.



Nano-Coatings Aid Preserving Environment

Iranian Company's ZR-Based Conversion Nano-coating are environment-preserving; by reducing usage of using dangerous chemical materials in products and they need mere water; making them appropriate for water scarce regions and are also non-sediment-and-mud nano-coating.

In recent years, Schiller Farayand Pars Company, has done a great help to preserve the environment by offering Zirconium-Based Conversion Nano-coating into the market. These nano-coatings are replacements of current coatings, used in several Iranian home appliance manufacturing companies and have reduced usage of using dangerous chemical materials in production of products like washing machine, fridge,



radiator, heater, cooler and package to the least possible level. The Protective coatings commonly used on metal surfaces, need compounds which are hazardous for the environment and can incur lots of damages to people in the workplaces as well as the environment.

The Sales Engineering Manager of the company says:” We have offered Zirconium -Based Conversion Nano-ceramic into the market with optimum usage for paint adhesion and increasing the resistance of the base metal. One of the benefits of this technology is reducing the needed final coating on the surface of the metal to a significant possible extent. For example, 10,000 nano-meters of nano-coating on a part will be decreases below 100 nano-meters by using this conversion nano-coating.

He added; “Current coatings in industries, like zinc, nickel, manganese and phosphate, have environmental problem. But ours has no harm for the environment. On the other hand, the current coatings use lots of water, but the abovementioned Nano-coating needs mere water and they are appropriate for the environment especially in the regions which are faced with water scarcity. In previous methods, lots of sediment and mud were produced and so lots of equipment had to be used for filtering sediment from the solution. But this a non-sediment-and-mud nano-coating. Also, this nano-coating is more appropriate for operators and laborers as they are in touch with healthier materials and have less side effects for the healthiness of the staff”.

Antimicrobial Textiles, Topic of The Ninth Iran-led International Standard

The ninth Iran-led international standard was published entitled "Nanotechnologies-Evaluation of the antimicrobial performance of textiles containing manufactured nanomaterials".

This standard was developed with the support and supervision of Iran's Nanotechnology Innovation Council (INIC) after three years of tireless efforts by a working group consisting of university professors and experts.



This standard describes how to evaluate the antibacterial performance of textiles containing manufactured nanomaterials (metal or metal oxide), also known as TCMNM. The textiles in this standard include fabric, yarn and fiber in which manufactured nanomaterials are used during production or finishing process. Further, this standard also specifies protocols to determine the quantity of nanomaterials released from textile following washing or exposure to artificial human body sweat. It covers the antibacterial, antifungal, and the anti-odor performance assessment method of TCMNMs. This document does not cover textiles that have therapeutic application as well as environment, health and safety (EHS) issues related to TCMNMs. Further, it does not cover the release of nanomaterials from TCMNMs as a result of aging, dry attrition and abrasion.

This standard was proposed and developed by INIC in 2018. After primary approval of Iran's proposal by the participating member countries of the ISO's Technical Committee on Nanotechnology (ISO/TC 229), extensive studies were conducted and several expert meetings were held with Iranian and foreign experts. These meetings were held to reach a consensus among international experts as representatives of ISO participating member countries. The standard was finally published in October 2021 at the official website of the International Organization for Standardization (www.iso.org).

94 international standards have been published by the ISO's Technical Committee on Nanotechnology Standards (ISO / TC 229). Among them, 9 standards have been developed by leadership of Iran. It usually takes 3 to 4 years to develop international standards. An international standards in the ISO is approved by general consensus among member countries. There are 39 participating members as well as 18 observing members in the ISO's Technical Committee for Nanotechnology Standards.

Iran-Philippines International Virtual Symposium on Agricultural Nanotechnology

Iran-Philippine International Virtual Symposium on Nanotechnology in Agriculture will be held on November 17-18, 2021.

Iran-Philippine International Virtual Symposium will be held with the aim of initiating joint scientific cooperation between Iran and the Philippines in the field of nanotechnology in agriculture and drawing new horizons for extension of cooperation in areas such as scientific

research, exchange of scientific and technological information, and nurturing effective interaction between relevant sectors of the two sides.

Dr. Mameni, Secretary of the Executive Committee of the Symposium expressed her hope that with the presence of faculty members and researchers active in the field of nanotechnology and agriculture, the symposium would be very fruitful and effective.



Agriculture Biotechnology Research Institute of Iran (ABRII) and Philippines Council for Agriculture, Aquatic and Natural Resources Research and Development of the Department of Science and Technology (DOST-PCAARRD) jointly organize the virtual scientific symposium on agricultural nanotechnology. This symposium is being held in partnership with Iran Nanotechnology Innovation Council (INIC), Iran Agricultural Research Education and Extension Organization (AREEO), and Philippines Department of Science and Technology (DOST), aiming at initiating and expanding scientific collaboration between the two countries with the following objectives:

- promote exchange of information on agricultural nanotechnology between the two sides
- create new horizons for interaction among public and private sectors who are active in the agricultural nanotechnology fields in the two countries
- assess and expand Iran and the Philippines' cooperation in the agricultural nanotechnology
- provide a platform to introduce small and medium enterprises (SMEs) and knowledge-based companies from agricultural nanotechnology fields to potential partners and funding organizations

The symposium will cover following topics:

- Nanotechnology Applications in Crop Protection
- Nanotechnology for Sustainable Crop Management
- Nanotechnology Applications in Food sciences and water sciences
- Nanobiosensor Applications in Agriculture

Iran-made Anti-Corrosion Epoxy Nano Paint

An Iranian company has successfully produced and marketed epoxy paints containing nanomaterials used for increasing anti-corrosion property.

Corrosion is still considered as a major problem in various industries causing industrial breakdowns and loss of tens of billion dollars.

Corrosion-resistant paints protect metals from damages caused by moisture, salt mist, oxidation or exposure to industrial chemicals. Anti-corrosion coating protects metal surfaces and acts as a barrier for preventing contacts of chemical compounds and corrosive agents with substrates.

Graphene oxide nanosheet is used as an additive in the anti-corrosion epoxy paints produced by Nano Arisa Pooshesh company. The presence of this nanosheet procrastinates the direct contacts of moisture and oxygen with the painted surface. Graphene oxide nanosheets, on the other hand, significantly increase the adhesion of the paint to the substrate due to its hydroxyl functional groups. Capabilities such as increased corrosion resistance, fire resistance, scratch resistance, antibacterial property, and increased UV resistance can be enhanced in a variety of coatings.



Export of UV-resistant wallcoverings

Azaran Faza Nama Company successfully exports its nanotechnology-based UV-resistant wallcoverings to several countries. Required technologies for these coverings were developed under mutual collaborations with hi-tech Iranian companies.



Azran Faza Nama Company, as an Iranian company actively follows design and production of various types of false ceilings, PVC wallcoverings, false floors, as well as various types of office partitions and modern office furniture. "We produce PVC wallcoverings used for various products of the interior spaces of the building," Mr. Kianfar, CEO of the company, said, "recently, we have also decided to have some products which are used for exterior of buildings." However, sunlight is considered as a major challenge for these products and would change the color of the products. Major

international manufacturers of anti-UV coatings do not guarantee their products for Iranian customers due to high level of UV radiation in Iran. Therefore, the company developed an innovative method to produce anti-UV coatings to solve the problem. "Based on this technology, we used nanoparticles and several other additives along with polymer compounds to create coatings resistant to ultraviolet radiation. This product has already reached mass production and we export it to several countries," he added.

Country Report

JAPAN

Launch Advanced Research Infrastructure for Materials and Nanotechnology in Japan (ARIM) project for collecting and utilizing data using user-facility support network in 2021.

The goal of the ARIM project is to collect, aggregate, and share high-quality data generated across Japan. The NIMS hub-center will lead this project by leveraging its 20 years of equipment sharing know-how. The Nanotechnology Platform Japan (NPJ) program was launched in 2012 to enhance the shared advanced facilities and equipment owned by universities and national research organizations. These facilities and equipment have been used more than 3,000 times annually by a total of more than 20,000 researchers. The Advanced Research Infrastructure for Materials and Nanotechnology (ARIM) project was newly launched to collect, format and aggregate data generated nationwide, upgrade and expand existing databases by taking full advantage of existing shared facilities, human resources, know-how and real-time measurement data collection techniques. This is the first ever project of this kind in the world including the United States, despite its highly developed equipment sharing networks. Figure 1 shows project concept which constructed from triangle-projects, ARIM, NIMS Central Data Center, and R&D Projects for Materials-Data Creation and Utilization.

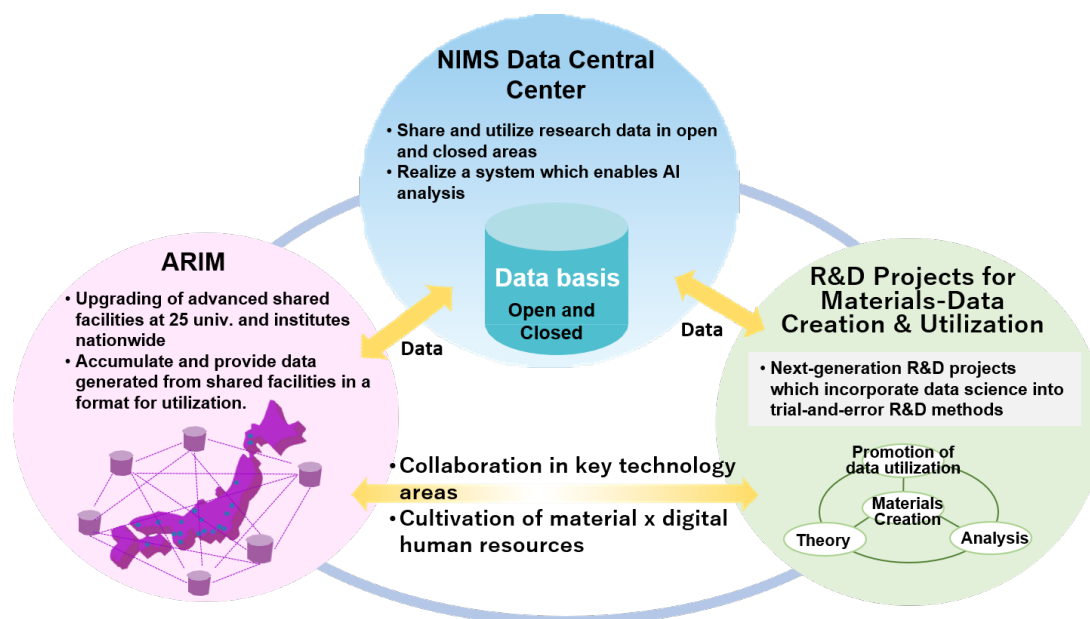


Fig. 1 Triangle-projects in Japan, Advanced Research Infrastructure for Materials and Nanotechnology in Japan (ARIM), NIMS Data Central Center, and R&D Projects for Materials-Data Creation and Utilization.

NIMS is highly qualified to lead this new project. Since its foundation 20 years ago, it has actively collected and used materials data, directed and supervised the NPJ program and run its own advanced equipment sharing programs. Through these experiences, the ARIM to collect data nationwide will continue to develop.

NIMS has learned that a wide range of high-quality data can be efficiently gathered by making its state-of-the-art equipment accessible to researchers and collecting their data. This lesson was effectively incorporated into the recently launched advanced materials research infrastructure project. Figure 2 shows organization of ARIM project joining 25 universities and institutes in Japan. The project consists of a central hub, local hubs and spokes functions as show in Fig. 2. The spokes refer to research facilities at which high-quality data is actually generated. The local hub sites aggregate, format and structuralize high-quality data generated at the spokes and their own facilities. A group of spokes and local hubs is formed for each key technological field, allowing efficient generation of field-specific data using specialized equipment. NIMS, having assumed the role of the central hub, will work to optimize the operation of the entire project.

Advanced Research Infrastructure for Materials and Nanotechnology (Fy 2021 - 2030)

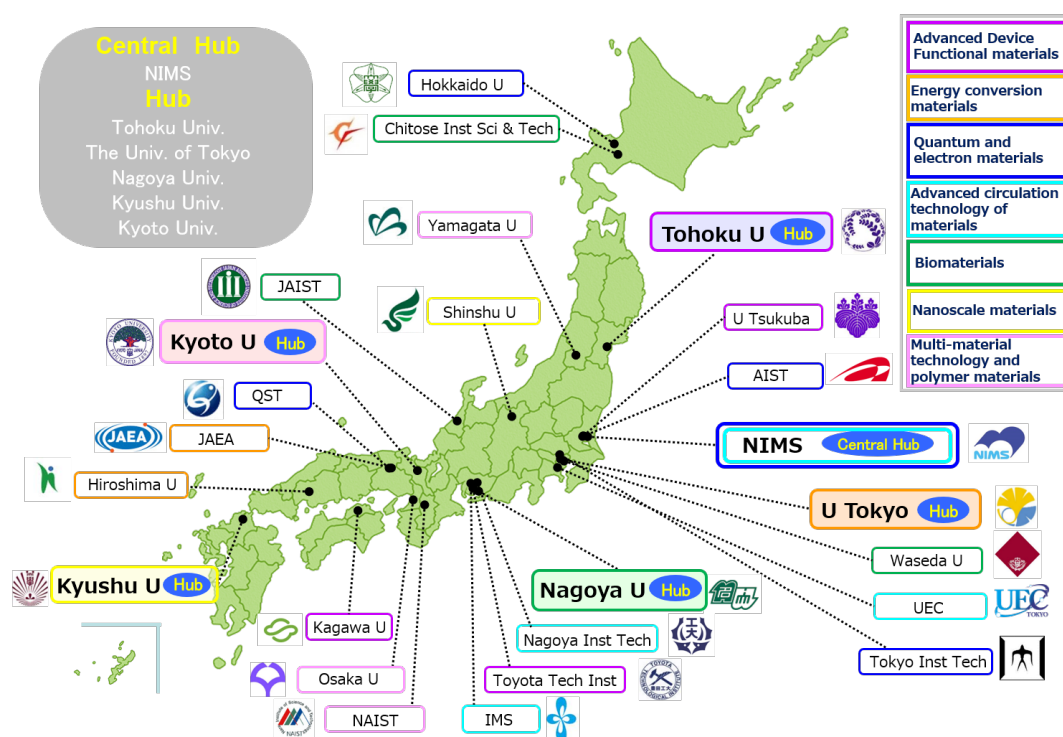


Fig. 2 Organization of ARIM project joining 25 universities and institutes in Japan.

For the project to succeed, data generation functions and the core data center will need to work together closely. Data must be collected from advanced equipment by individuals who are knowledgeable about raw data handling, data structure, data formatting and ways in which data will be used. Top-down management is inappropriate for this project. It will be vital for the representatives of the central hub, local hubs and spoke functions to communicate closely. This project is scheduled to last 10 years. Advanced materials research infrastructure needs to be created in line with this time frame. The data collection environment, including computing power and advanced research equipment, is expected to change significantly within the next 10 years. We need to create data collection infrastructure and generate data capable of withstanding these changes. In addition, it normally takes 20 to 30 years for the results of a research project to be put into practical use. A major goal of data-driven research is expediting

this process. Ten years seem like a long time but it will pass very quickly. This project to create materials DX platforms will help Japan lead the world in the development of materials that can fulfill social needs.

[Quantum 2.0 Overview](#)

Country Report

KOREA

NANO KOREA 2021

[NANO KOREA](#), the largest international event in the field of nanotechnology in Korea was held in July 2021 with the slogans 'NANO! Energy for Technology Innovation'.

Name of event	NANO KOREA 2021 - The 19 th International Nanotech Symposium & Exhibition
Slogan	NANO! Energy for Technology Innovation
Date	July 7 th (WED) ~ 9 th (FRI), 2021
Venue	KINTEX Exhibition Center I, Gyeonggi-do, South Korea & Online
Registered participants	1,545
Presentations	954 presentations from 17 countries



For the successful development of nanotechnology, Nobel Prize winner Professor Amano Hiroshi of Nagoya University participated in this year's keynote speech at NANO KOREA as a representative of the industry and research institute. The opening ceremony program consisted of an opening ceremony, award ceremony and invited lectures. The rest of the symposium programs, including technical sessions, public sessions, special session and poster sessions all

be held in a hybrid format to increase the participation rate of domestic and foreign registrants and hold safe and practical events against quarantine and restrictions caused by COVID-19.

The technical session covered important issues in nanoscience and nanotechnology and consisted of 12 different technical departments. In particular, this year, an online open session was operated so that anyone who visited the website could freely access it, and lectures from all sessions were displayed on the website of NANO KOREA 2021 during the symposium. Through this open session, teenagers encountered nanotechnology and provided short practical experience in nanotechnology experiments. In addition, NANO KOREA provides an opportunity to understand the latest research results and trends related to the nanotechnology field, while provided a place for researchers and experts to networking. The organizing committee plans to make the event more attractive by increasing the content of nano-convergence-related industries that will lead Korea's sustainable growth and future new industries.





Nature Conference 'Bio-Inspired Nanomaterials'

Korea Nanotechnology Research Society(KoNTRS) co-hosted [Nature Conference 'Bio-Inspired Nanomaterials'](#) for the third time in Korea with the journals of Nature Research. The conference was held from November 15 to 17, 2021 at Seoul National University as an on•offline hybrid conference. The Nature Conference is the one of the most influential academic event where the participants can have great opportunities to communicate with researchers and editors from the society of 'Nature'. This event was held for promoting the NANO KOREA Symposium to international academic community and the scientific journal '[Nano Convergence](#) (Open Access, SCIE, 2020 IF = 8,526)' which is published by KoNTRS to get more international readership.

The conference was held under the theme of "Bio-inspired Nanomaterials," focusing on Synthesis, Assemblies, Nanobiophotonics, and Nanomedicine. 241 presentations were presented during the conference including 3 plenary lectures by Prof. Nicholas Kotov from University of Michigan in USA, Professor Luis Liz-Marzan from CIC biomaGUNE in Spain, and Prof. Taeg Hwan Hyeon from Seoul National University in Korea.

In addition to the main sessions, there are many great networking sessions for the participants where they can meet the editors of Nature journals. The participants could communicate and discuss about the Nature journals with the editors and get useful advices how they can write and publish their papers in the journals, including '1:1 meet the editor sessions' which the editors and the participants had in-depth communications for 15 minutes each through online.

The organizing committee recognized the best poster presentations. There were 1 gold winner and 3 silver winners from each of sessions. The winners received certificates of award, prize money and Nature journal free subscription for a year (only for gold winners).

Name of event	Nature Conference 'Bio-Inspired Nanomaterials'
Date	November 15 th (MON), 2021 ~ 17 th (WED),
Venue	Hoam Faculty House, Seoul National University, South Korea
The number of participants	407
Presentation	241 presentations from 29 countries
 	
 	

Country Report

MALAYSIA

Contributors:

National Nanotechnology Centre (NNC)

NanoMalaysia Berhad (NMB)

NanoMalaysia Celebrated Its 10th Anniversary (NMB)

NanoMalaysia celebrated its 10th Anniversary on 1 August 2021 with a virtual celebration shared on its social media platforms. The event was officiated by the Deputy Minister of MOSTI, Yang Berhormat Datuk Haji Ahmad Amzad bin Mohamed Hashim and attended by NanoMalaysia's Chairman, Professor Emeritus Dato' Ir. Dr Mohamad Zawawi Bin Ismail, as well as NanoMalaysia's CEO, Dr Rezal Khairi Ahmad. Reflecting on the last decade, Dr Rezal said: "We have grown from strength to strength – all made possible due to the valued support and contributions from MOSTI, stakeholders, industry partners, research and consumer groups, and the NanoMalaysia team".

NanoMalaysia has also been roped in as one of the implementing agencies for key segments of the recently introduced National 4IR Policy, namely Advanced Materials and Technologies, Internet of Nano-Things, Blockchain and Artificial Intelligence. As part of the initiative, two programmes under NanoMalaysia – the REVOLUTIoNT and Hydrogen EcoNanoMy programmes will be launched. REVOLUTIoNT will facilitate and commercialise the production of complex and valuable intellectual property, products and systems solutions while Hydrogen EcoNanoMy will apply NanoMalaysia's on-site generated Hydrogen technology to create a National Hydrogen Industrial Ecosystem for the energy sector.

NMB's role in the National 4IR Policy is integral in driving Malaysia closer towards the aspirations of the National Policy on Science, Technology and Innovation (DSTIN) 2021 – 2030 in becoming a high-tech nation by 2030. The 4IR, with nanotechnology as one of its primary technological pillars, is forecasted to boost all sectors' productivity by 30 per cent by 2030 and will contribute to our country's increase in skilled workers as well as production of higher value- added products.



ANF Commercialisation Workshop 2021 (NMB)

The Asia Nano Forum (ANF) Workshop on Commercialisation 2021 was organised during the 18th Asian Nano Forum Summit 2021 (ANFoS2021) on 16 August 2021. The Workshop was organised by NanoMalaysia Berhad, led by Dr Rezal Khairi Ahmad, in collaboration with the ANF Working group on Commercialisation and NANOTEC Thailand as the host of ANFoS2021. Companies from Malaysia and NanoMalaysia's partners which attended the workshop were:

1. IP Commercialisation Strategy - Mr Raguraman Gurusamy, (CEO) Global IP Ventures (Malaysia)
2. The Formulation of Cosmetic Products Using Nanotechnology and Nanophytochemicals - Ms Savina Kaharuddin, (CEO) VNI Scientific (Malaysia)
3. Nanofluid For Cooling - Bernard Sagaiyaraj, (Director) Blue Snow Energy (Malaysia)

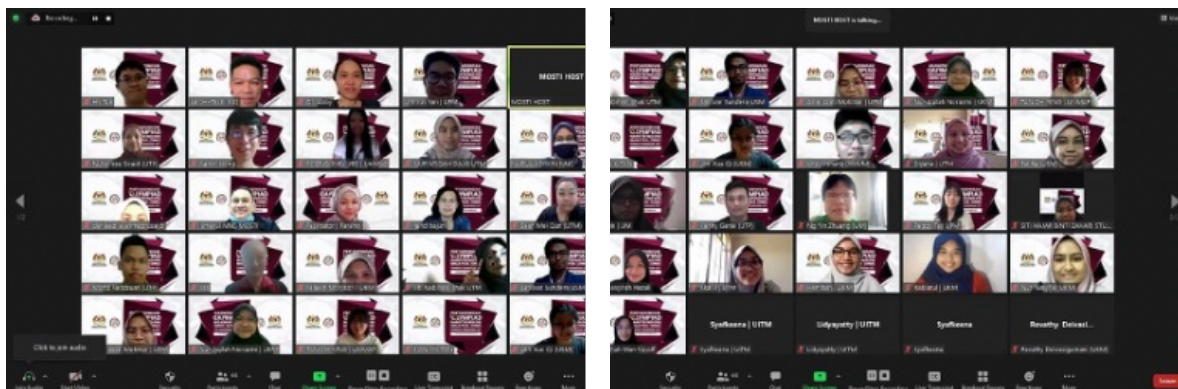
SIRIM - Industry Dialogue on NanoSafety (NMB)

NanoMalaysia's subsidiary, NanoVerify Sdn Bhd participated in the SIRIM-Industry Dialogue in Nanosafety which was held on 9 August 2021. SIRIM is an industrial research and technology organisation in Malaysia, wholly-owned by the Malaysian government and is mandated as the machinery for research and technology development, and the national champion of quality. During the dialogue, NanoVerify's Managing Director, Mr Johan Iskandar Hasan shared his insight on "Meeting the Consumer Expectations of Nanoproduct Functionalities."

Malaysia Nanotechnology Olympiad (ONM) 2021 (NNC)

ONM is a national level competition organized by National Nanotechnology Center targeted at undergraduates and graduates from the local universities, both public and private. This competition conceptualizes real scientific and industrial solutions to current issues and global challenges. Participants are required to submit ideas and solutions using nanoscale technology.

This year's competition recorded a total of 452 participants. An online exam-oriented screening was conducted over two sessions on the 27th and 30th August. The highest scoring top 30 were invited to an ONM camp held virtually from 19th to 25th September 2021. Lim Jun Yan of Universiti Putra Malaysia was announced the winner of ONM 2021. Kenny Anak Ganie of Universiti Teknologi Petronas and Nur Aqilah Zahirah of Universiti Kebangsaan Malaysia took home the first and second runners up medals, respectively. The top five finalists stand to represent Malaysia in the next International Nanotechnology Olympiad.



Minister of Science, Technology and Innovation visited NanoMalaysia and Its Project Partner (NMB)

On 14 October 2021, the new Minister of Science, Technology and Innovation, Dato Seri Dr Adham Bin Baba visited NanoMalaysia's office in Kuala Lumpur and met with the management team lead by NanoMalaysia's Chairman, Professor Emeritus Dato' Ir. Dr Mohamad Zawawi Bin Ismail, and NanoMalaysia's CEO, Dr Rezal Khairi Ahmad where the Minister was briefed on NanoMalaysia's activities and achievements. Later, the Minister visited one of NanoMalaysia's project partners, Nanopac Sdn Bhd to view the projects and products commercialised by NanoMalaysi, including the Nano Light Energy Panel (NLEP).



NANOKEB 2021 (NNC)

National Nanotechnology Center supported by NanoMalaysia Berhad organised the annual national event on nanotechnology, known as NanoKEB from 23rd to 27th October 2021 virtually via <https://nanokeb.com/>. The three main aims of NanoKEB are: to serve as a knowledge and information sharing platform on the local development of nanotechnology; to foster discussions and engagements related to issues and the direction of R&D in nanotechnology; and a medium to inculcate awareness on nanotechnology to the public, especially among students. The five-day event was filled with seminars, competitions,

workshops and was officially closed by the Secretary General of the Ministry of Science, Innovation and Technology, Datuk Zainal Abidin Bin Abu Hassan.



Webinars and Forum under NANOKEB 2021 (NMB)

NanoMalaysia participated in the NANOKEB 2021 NanoSummit Conference and Exhibition which was held from 23 to 27 October 2021 and organised a webinar on nanotechnology commercialisation and webinars presented by its project partners under the Nanotech Talk Series 2021. Speakers in the Nanotech Talk Series were Dr Mariam Firdhaus binti Mad Nordin, Senior Lecturer (UTM) and Managing Director of AM Zaideen Ventures Sdn Bhd; Ir. Bernard Sagaiyaraj, Director, Blue Snow Group; Dr. Mohammad Khalid, Professor, Sunway University; Runeel Daliah, Senior Analyst, Lux Research; Suriyia Sadanathan, Head of Patent Department, Mirandah Asia (Malaysia) Sdn Bhd and Mohamed Fairuz Bin Mohd Pilus, Perbadanan Harta Intelek Malaysia. The speakers shared their experience and knowledge in nanotechnology industrialisation, commercialisation and intellectual property. At the same conference, a forum titled “Nanotechnology Initiatives Under The Twelfth Malaysia Plan (RMK12)” was also held and the panelists included NanoMalaysia’s CEO, Dr Rezal Khairi Ahmad and the Director of the National Nanotechnology Centre (NNC), Dr Ruslinda Binti A. Rahim.

Launch of REVOLUTIoNT (NMB)

On 5 November 2021, NanoMalaysia Berhad launched REVOLUTIoNT, an initiative under the National 4IR Policy that was recently introduced by the Malaysian government. It is one of the policy’s key pillars that focuses on nanotechnology and the development of The Internet of Nano Things (IoNT) products and applications to enhance solutions for various applications in food and agriculture; wellness; medical and healthcare; electronic devices and systems; and energy and the environment. The virtual launch was officiated by the Minister of Science, Technology and Innovation, Dato Seri Dr Adham Bin Baba. REVOLUTIoNT’s objective is to

seamlessly link, improve and digitalise NanoMalaysia's existing projects while paving the way for future innovations – resulting in a convergence of technologies to create a cohesive and well-connected IoNT ecosystem.



ISO/TC 229 Nanotechnologies Meeting (NNC)

Malaysia participated in the ISO/TC229 Plenary and associated meetings held virtually 8-19 November 2021. Malaysia (DSM) and Colombia (ICONTEC) lead the revision of ISO/TS 12091:2014 Occupational risk management applied to engineered nanomaterials – Part 2: Use of the control banding approach. The project group had its meeting on 16 November 2021 with the participation of 30 experts.

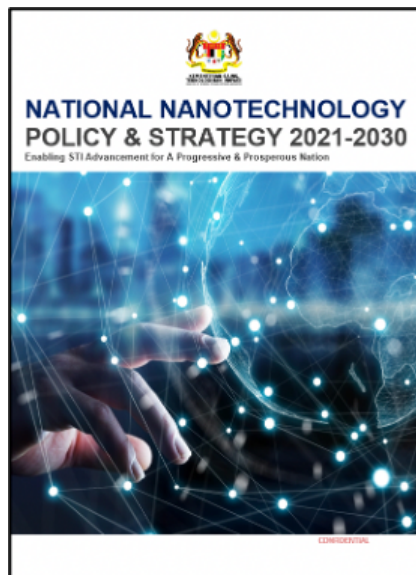
Malaysia continues to work on the draft document, registered as a Preliminary Work Item (PWI 4963), titled 'Radiotelemetry-spectral-echocardiography Based Real-Time Surveillance Protocol for In Vivo Toxicity Detection and Monitoring of Engineered Nanomaterials (ENM)'. The meeting was held on 17 November 2021 with a participation of 23 experts.

MOU between NanoMalaysia and MyIPO (NMB)

On 11 November NanoMalaysia Berhad signed a Memorandum of Understanding (MOU) with Intellectual Property Corporation of Malaysia (MyIPO) for Technology Innovation Support Centers (TISC) programme. This MOU is a one of the intermediate steps for NanoMalaysia to become a Centre of Excellence for intellectual property (IP) strategic management through participation in IP training programmes, such as patent search technique training, patent drafting training, commercialisation training and intellectual property marketing, conducted and coordinated by MyIPO, together with the World Intellectual Property Organization (WIPO). The signing of this MOU will allow NanoMalaysia access to technical information, which is a vital factor in the objectives and goals of NanoMalaysia, for both short and long term in monetizing IPs jointly developed with start-ups, small and medium enterprises

and universities. The MOU will focus on efforts to intensify technology transfer activities between universities, local research institutions and industry players.

National Nanotechnology Policy and Strategy 2021-2030 (NNC)



“ The Minister of Science, Technology and Innovation Malaysia has launched the National Nanotechnology Policy and Strategy on 15 November 2021 with the theme ‘Enabling STI Advancement for a Progressive and Prosperous Nation’. This policy consists of four strategic thrusts: Strengthening Ecosystem and Governance; Advancing Research and Development; Enhancing Commercialization and Energizing Industries; and Strengthening Standard, Safety and Regulation. Implementation will be supported by a total of 15 strategies and 32 initiatives to carry the nation’s nanotechnology agenda all the way to year 2030. The Malay version of this policy can be accessed at <https://www.mosti.gov.my/dasar/> while the English version will be made available soon.

Launch of NanoMalaysia Energy Storage Technology Initiative (NESTI) programme and demonstration of Hydrogen Paired Electric Racecar (HyPER) (NMB)

On 23 November 2021, NanoMalaysia Berhad launched its NanoMalaysia Energy Storage Technology Initiative (NESTI) Programme. NESTI’s objective is to lead Malaysia in the development and commercialisation of energy storage systems crucial for electric mobility, excess grid and renewable energy and uninterrupted power supply for commercial and domestic buildings uses. It will also be applied in portable applications for use in micro businesses including batteries, ultracapacitors, hydrogen storage, energy management systems and battery recycling. NESTI will facilitate a transition towards greater e-mobility adoption amongst Malaysians. This is in line with aspirations to make Malaysia a high-tech and high-income nation by 2030, and importantly reaching Carbon Neutrality 2050 target. There was also a demonstration of the first fuel cell powered Electric Vehicle for use in the motorsports industry in Malaysia known as the Hydrogen- Paired Electric Racecar (HyPER) during the launch. Hyper is powered by NanoMalaysia’s Hydrogen and Hybrid Energy Storage System (H2SS). HyPER, aims to mobilise the Malaysian automotive and transportation sectors in the direction of renewable energy, specifically green hydrogen as a first step towards a Hydrogen Economy. NESTI was launched by the Minister of Science, Technology and Innovation, Dato Seri Dr Adham Bin Baba. In a statement, NanoMalaysia’s CEO, Dr Rezal Khairi Ahmad said that NESTI is testament to the readiness of NanoMalaysia’s nanotechnology industry and research partners to establish a solid baseline in the energy storage sector and Malaysia’s readiness to

participate in the renewable energy sector, especially in the regional value and supply chains for electric vehicles and solar panel installations.



Launch of NanoMalaysia Autonomous Vehicle Initiative (NAVi) and Demonstration of NAVi-Delivery Robot

On 30 November 2021, the Minister of Science, Technology and Innovation, Dato Seri Dr Adham Bin Baba launch the NanoMalaysia Autonomous Vehicle Initiative (NAVi) and NAVi-D (Delivery) as an initiative under NanoMalaysia Berhad to produce a Level 4 Autonomous Vehicles (AVs) or driverless vehicles and platform in Malaysia, geared towards the development of technologies related to the 4th Industrial Revolution 4.0 (4IR). NAVi is focused on the transportation sector while NAVi-D will be equipped for the last mile delivery sector. NAVi-D (Delivery) is an evolution from NAVi focusing on delivery of parcels and food products. NAVi-D's core technology is based on NAVi's software architecture enhanced for this specific application.



Memorandum of Agreement on EV Micro Mobility Ecosystem in Malaysia (NMB)

On 2 December 2021, the Minister of Science, Technology and Innovation (MOSTI) Dato' Sri Dr Adham Bin Baba witnessed the inking of a Memorandum of Agreement (MOA) with a targeted investment value of USD30 million, aimed at making Malaysia an exporter of EV components for use in the micro mobility ecosystem, in the ASEAN region. The multi-party MOA was signed between NanoMalaysia Berhad, Hyundai Kefico Corporation, Tham Corporation, Curo Co. Ltd, Hyundai Electric and Energy Systems Co. Ltd, Daegu Mechatronics & Materials Institute (DMI) and Signet EV. It underscores a collaborative initiative for Malaysian companies to provide a wide range of technology components in the production of two-wheel and four-wheel electric vehicles (EVs) in the global marketplace thus positioning the country as a leading EV nation in this region. This will comprise nanotechnology-based components such as high-performance batteries, ultra- capacitors, solid state hydrogen and energy management and monitoring systems.

The collaboration members have agreed to cooperate in providing a total solution to an EV Micro- Mobility Ecosystem in Malaysia, including EV two-wheeler and potentially EV 4-wheeler in Malaysia with Malaysian core technical components. NanoMalaysia will play an integral role in the development of energy storage technologies (batteries, ultra-capacitors, solid-state hydrogen, energy management and monitoring systems), as well as high performance motor controller for mobility applications through NanoMalaysia Energy Storage Technology Initiative (NESTI). The deployment of Malaysian energy storage, energy management and monitoring system and controller component will be utilised for integration into electric vehicles including Micro Mobility co- developed with Curo Co., ltd, Hyundai Kefico, Hyundai Electric and ThamLEV.



The Launching of Eclimo e-Motorbikes: Nanostructured Batteries and Monitoring System (NMB)

On 9 December 2021, NanoMalaysia and its project partner, Eclimo Sdn Bhd launched an electric motorbike with a Nano-Structured Battery Monitoring System (BMS), known as the ES-11. The BMS can monitor battery health; send out alerts when the battery voltage drops, and come with a tracking and geo-fencing system that can be controlled via a mobile app. The launch was officiated by the Minister of Science, Technology and Innovation, Dato' Sri Dr Adham bin Baba. The ES-11 has a convenient 3-pin plug socket charging system. This solves the problems that frequently accompany electric vehicles (EV): the lack of infrastructure and charging stations. Its Nano-Based Lithium-Ion Battery Cell has a life cycle of 1,000 charges and each charge will enable a travel distance of 100 kilometres (km). The ES-11 was jointly produced by both companies – with NanoMalaysia owning the intellectual property rights (IPR) of the BMS.



Country Report

THE PHILIPPINES

DOST-ITDI, together with the Department of Trade and Industry's Bureau of Philippine Standards (DTI-BPS), is continuously spearheading the establishment of the National policy/standards on Nanotechnologies by conducting monthly technical committee meetings on Nanotechnologies. Amidst the COVID 19 pandemic, BPS/ TC-85 on Nanotechnologies have reviewed, endorsed, published, and adapted thirty-two (32) Philippine National Standards on Nanotechnologies in 2021.

To further increase experts in nanotechnology, DOST embarked on a new partnership with MAPUA University by signing a Memorandum of Agreement (MOA) to implement the "Doctor of Philosophy (Ph.D.) in Material Science and Engineering (MSE) with specialization in Nanotechnology by Research Program." This partnership will be the first Ph.D. program by research being offered in the country that aims to develop expertise in the field of nanotechnology and to increase the pool of nanotechnology experts to help accelerate science, technology, and innovation and, to a greater extent, contribute to the country's goal of improving its rank in the global innovation index through cooperation and collaboration. It also aims to provide the necessary technical knowledge and hands-on training to graduate students in conducting their research projects in nanotechnology, aligned with the DOST Harmonized National Research and Development Agenda (HNDRA) as curriculum requirement Doctoral dissertation in the program.

The program is scheduled to commence early next year. Successful applicants will receive scholarships from the Science Education Institute (DOST-SEI). They will be allowed to conduct their researches at the Industrial Technology Development Institute (DOST-ITDI) through its Nanotechnology and ADMATEL laboratories guided by its nanotechnology experts as advisers focusing on biomedical applications, human security, and nutraceuticals.

The ceremonial virtual signing of the MOA, as seen in Figure 1, was attended by DOST and MAPUA University officials led by DOST Secretary Fortunato de la Pena and MAPUA President Dr. Reynaldo B. Veal.

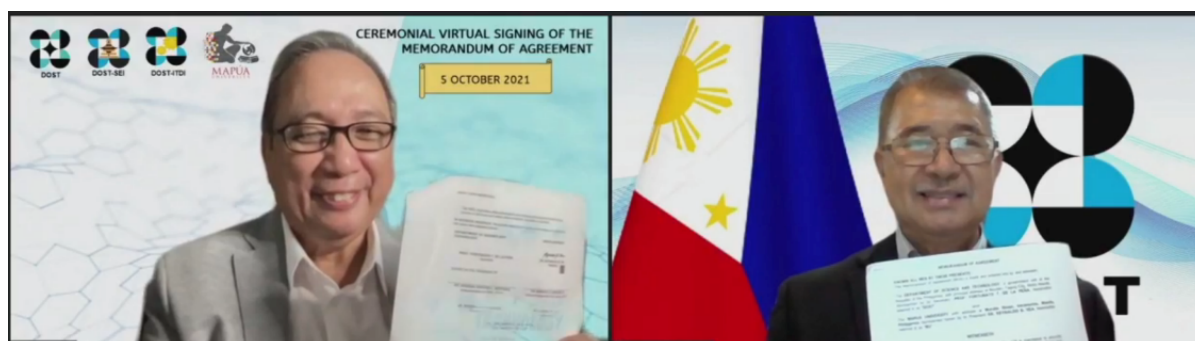




Figure 1. Screenshots of the DOST and Mapua University officials during the ceremonial virtual signing of MOA

The Philippines participated in the 7th Thailand International Nanotechnology Conference (NanoThailand 2021) that was held virtually last December 16-17, 2021. The NanoThailand 2021 Conference focused on integrating Engineering, Materials Science, and Nanotechnology to address fundamental nanotechnology opportunities and their applications. Engr. Jocelyn P. Reyes from the Materials Science Division and Mr. Admer Rey C. Dablio from the Standards and Testing Division, both from DOST-ITDI, presented their research entitled “Acute Toxicity and 28-Day Repeated Dose Studies of Multi-Walled Carbon Nanotubes” and “Establishment of Metrological Traceability of Nanomaterial Size Measurement in the Philippines through Conduct of a Local Interlaboratory Comparison using Polystyrene Nanosphere Standards,” respectively.



Figure 2. Screenshots of the Oral Presentation at NANOTHAILAND 2021

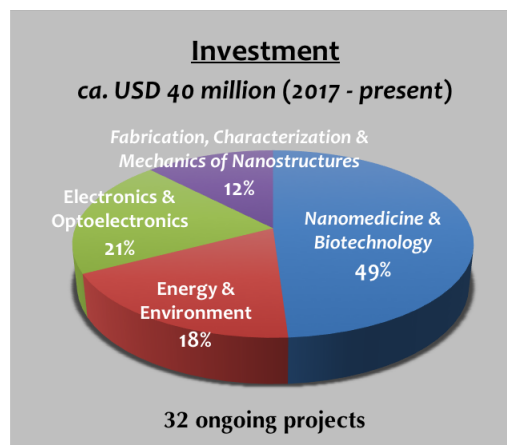
Country Report

TAIWAN

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) launched the Call for Proposals 2022 recently. The four thematic areas are “*Nanomedicine and Biotechnology*”, “*Nanomaterials for Energy and Environment*”, “*Nanoelectronics and Optoelectronics*” and “*Fabrication, Characterization and Mechanics of Nanostructures*”. In addition to the 3-year Innovation and Application project (2015~present) from a basic “Concept Development” of Technology Readiness Level (TRL2~3) to a more advanced “Prototype Validation” (TRL4), a 2-year Advanced Research project (2021~) for cutting-edge scientific discoveries was added to the Call for Proposals 2022 to encourage the PIs of 2-y project to continue a next 3-y project.

By linking policy programs such as MOST Germination Program and Industrial Value Creation Program for Academia (IVCPA) by Ministry of Economic Affairs (MOEA), it is expected to inspire researchers' in-depth thinking of technology commercialization and to achieve their entrepreneurial ambition. Some research teams funded by MOST grants have initiated startups, such as NaviFUS Co., Ltd, Instant NanoBiosensors Co., Ltd, and TaiCRO Co., Ltd. for medical devices genre.



Taiwan's nanoMark Certification System



Founded by Industry Development Bureau, Ministry of Economic Affairs in 2004 and transferred to Taiwan Nanotechnology Industry Development Association (TANIDA) in 2017, Taiwan's nanoMark verification system is the first nano-product certification system in the world and by the end of 2021 has 17 certified firms with 98 product types and 1299 product models in five product categories, including *Sanitary Equipment*, *Paint*, *Textile*, *Building Materials*, and *Others*. For testing services, there are currently 52 testing specifications and 14 certification testing labs with 156 testing items around Taiwan.

Sanitary Equipment (4 firms)

- Anti-fouling Sanitary Ceramic Ware
- Anti-bacterial Sanitary Ceramic Ware

Paint (4 firms)

- Self-Cleaning Paint
- Photocatalytic Deodorization Coating
- Anti-bacterial Paint

Textile (2 firms)	<ul style="list-style-type: none"> • Far Infrared Textiles • Anti-bacterial Textiles
Building Materials (4 firms)	<ul style="list-style-type: none"> • Antifouling Ceramic Tiles • Weather-resistant Al Frame • Anti-bacterial Steel
Others (3 firms)	<ul style="list-style-type: none"> • Transparent Heat Insulation Film • Plastic Containers • Lubricants for Wear

The establishment and promotion of the nanoMark was a part of Taiwan's National Nanotechnology Program which was responsible for research development and technological transfer to industries. The purpose of the nanoMark is to protect consumers' rights and interests, to encourage sustainable development for outstanding companies and to enhance the international competitiveness of nanotechnology industry. The results of a market research indicated that not only can the nanoMark help the companies who have passed the nanoMark certification to increase their "corporate image", gain customer confidence and promote "market sales".

Nanotechnology Standards in Taiwan

Taiwan's National Standards are drafted and revised to respond to the needs of manufacturers, consumers and other users, with a view to applying a set of consistent standards to domestic products, procedures and services. Some nanotechnology standards related to ISO during recent years are as follows.

Code	Title	Published
CNS 15377: 2021 R3210	Fine ceramics - Light source for test of photocatalytic materials used under ultraviolet	2021
CNS 15378-1 R3211-1	Fine ceramics - Test method for self-cleaning performance of photocatalytic materials - Part 1: Measurement of water contact angle	2020
CNS 15378-2 R3211-2	Fine ceramics - Test method for self-cleaning performance of photocatalytic materials - Part 2: Decomposition of wet methylene blue	2020
CNS 15379 R3212	Fine ceramics – Test method for water-purification performance of photocatalytic materials by measurement of forming ability of active oxygen	2020
CNS 15380 R3213	Fine ceramics - Test method for antibacterial activity of photocatalytic products under photoirradiation	2020

Taiwan participated in ISO/TC 229



The 2021 ISO/TC 229 Nanotechnologies Interim Meeting was held on 17-21 May virtually during COVID-19. Dr. Tsing-Tang Song from Taiwan has participated in this online event on behalf of Asia Nano Forum (ANF), the

Liaison member of ISO/TC 229. There are currently three ISO/IEC Nano Standards led by ANF including IEC TS 62607-4-4:2016 (published), IEC TS 62844:2016 (published) and ISO TS 4971 (ongoing project). With regard to ISO TS 4971 "*Nanotechnologies – Performance evaluation of nanosuspensions containing clay nanoplates for quorum quenching*", it was registered as ISO PWI 4971 at WG5 (Products and Applications) in November 2019 and approved for a new project registered as ISO TS 4971 on 9 April 2021. Seven members from Canada, Iran, Japan, Korea, Mexico, Singapore, and the US nominated experts to participate in this project. The latest Liaison status of ANF at ISO/TC 229 and IEC/TC 113 are Liaison category A / TC level liaison (can propose new work items) at ISO/TC 229 (active, 1 ongoing project) and Liaison category C / WG level liaison (cannot propose new work items) at IEC/TC 113 (pending cancelation due to inactive), respectively.

Form 6: Result of voting on New Work Item Proposal

Date: 2021-04-09 ISO/TC 229
Title of TC/SC concerned: N 1968
Nanotechnologies

To be completed by the secretariat and sent to the ISO Central Secretariat and to all P- and O-members of the TC or SC concerned, with a copy to the TC secretariat in the case of a subcommittee.
Please attach the results of the NWP ballot from CIB to this form.

ISO/TC 229 N 1968: 1943	Consultation 2021-01-11	Deadline 2021-04-08
Title: English title: Nanotechnologies – Performance evaluation of nanosuspensions containing clay nanoplates for quorum quenching French title: Nanotechnologies – Évaluation des performances des nanosuspensions de nanoplates d'argile pour le quorum quenching		
Results (the compilation of results is given in an annex) The following criteria for acceptance have been met: <input checked="" type="checkbox"/> Approved by a 2/3 majority of the voting P-members, and <input checked="" type="checkbox"/> a commitment to participate actively in the development of the project by at least 4 P-members in accordance with ISO or IEC standards and at least 3 P-members in accordance with ISO or IEC standards. <input checked="" type="checkbox"/> Justification statements have been obtained (all negative votes must be accompanied by a statement justifying the decision, or they shall not be counted. See ISO/IEC Directives Part 1, clause 2.3.4).		

FORM 6 - Result of voting on NWP
Version 2017-08

1 of 2

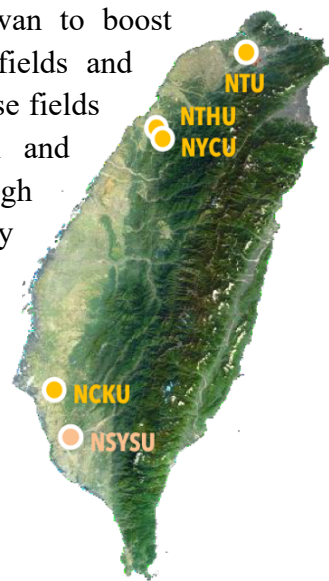
2021 Taiwan-USAF Nanostructured Materials for Sensing and Sustainment Final Program Review

The 2021 USAF-Taiwan Nanostructured Materials for Sensing and Sustainment Final Program Review was held online on 15-16 July, 2021 with four plenary sessions including "*Novel and/or Flexible Functional Materials*", "*Bio-inspired Materials for Sensing*", "*Novel and/or Flexible Functional Materials*", and "*Predictive Functional Materials and Materials for Quantum Phenomenon*". Principal investigators of all ten funded projects are asked to present their achievements. This joint program "Taiwan-USAF Program on Nanostructured Materials for Sensing and Sustainment" positioned in Technology Readiness Level (TRL) between 1 and 1.5 was initiated in 2018 by Taiwan Ministry of Science and Technology (MOST) and US Air Force Office of Scientific Research (AFOSR). 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. As a result of these joint projects, a number of international, particularly interdisciplinary research teams have been formed to challenge established boundaries in science and open up many new fields of research.



Talent Cultivation for Semiconductor Industry in Taiwan

According to the “National Key Fields Industry-University Cooperation and Skilled Personnel Training” Act promulgated in May 2021, there are currently 5 academies collaborated with industry have been established by leading universities in Taiwan to boost innovation of industry-university cooperation in national key fields and innovation of the training of skilled professional personnel for these fields to upgrade the effectiveness of the results of the research and development (R&D) achievements of national universities, train high level science and technology professionals, and enhance industry competitiveness.



- National Taiwan University (NTU)
[*Graduate School of Advanced Technology*](#)
- National Tsing Hua University (NTHU)
[*College of Semiconductor Research*](#)
- National Yang Ming Chiao Tung University (NYCU)
[*Industry Academia Innovation School*](#)
- National Cheng Kung University (NCKU)
[*Academy of Innovative Semiconductor and Sustainable Manufacturing*](#)
- National Sun Yat-sen University (NSYSU)
In the works (Approved by the Ministry of Education)

Taiwan Pavilion on nano tech 2022, Japan

Under the coronavirus disease 2019 (COVID-19) pandemic circumstance, the “nano tech 2022 – The 21st International Nanotechnology Exhibition & Conference” has a Onsite-Online hybrid format that combines physical exhibition from November 26, 2021 to February 28, 2022 and virtual exhibition on January 26-28, 2022 at Tokyo Big Sight. By organizing digital exhibition, Taiwan Pavilion continued the tradition and participated in this event, one of largest exhibition in the world held in Tokyo, Japan since 2001. New novel nano-materials, devices and techniques focusing on “Advanced Research”, “Medicine”, “Energy”, “Electronics / Optoelectronics”, “Materials” and “Characterization / Fabrication” 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.

Taiwan Pavilion

https://www.nanotechexpo.jp/taiwan_pavilion.html



Core Facility Center, National Cheng Kung University

- Monolayer transition metal dichalcogenide products and imaging technology
- In-Situ Detection Nanotechnology for Liquid-State Samples

Eternal Materials

- AR and Self-cleaning Coating For the Solar Panel

HSIN FANG NANOTECHNOLOGY

- *Super Micron Mill*

Agspring

- *Agspring Corporation*
- *Nano Application of various masterbatches*

Department of Physics, National Sun Yat-sen University

- *Full-color GaN micro LED display*

SILICAN BATTERY / National Cheng Kung University

- *Ultra-high purity multi-purpose nano-/micro-silicon powder*

Luxor Thermal

- *The technology to implant functional groups on CNT and Graphene surfaces*

Harvard Medical School Mclean Hospital / Taipei Medical University Shuang-Ho Hospital

- *Postintubation dysphagia management in COVID-19 patients and aging people using a novel nutrient supplement*

AKALI Technology

- *Long-lasting Antimicrobial Nano Coating*

Long Ti Nano Tech

- *Tinano*

UC Bacon

- *Graphene light weight heat insulation and light Blocking membrane and their application*

Nanovie

- *Nanovie HPAS Mono - High-precision alignment stacking system for 2D materials & heterostructures*
- *Nanovie Metal Xano - Metal Nanoparticle Generator*

Protrustech

- *3D Random Crossed-Wire SERS chip*

STRONG NANO TECH

- *Nano gold catalyst additives (Diesel fuel additives, Gasoline additive, Engine oil additives)*

Silicon Based Molecular Sensoring Technology

- *Ultra-high sensitivity semiconductor biosensor for real-time detection of COVID-19*

* Registration <https://unifiedsearch.jcdbizmatch.jp/nanotech2022/en/nanotech/details/Px35brjFuns>

Country Report

THAILAND

The National Nanotechnology Center (NANOTEC) is the leading agency on nanotechnology development in Thailand. Established on 13 August 2003, NANOTEC is one of four research agencies operating under the jurisdiction of the National Science and Technology Development Agency (NSTDA) and the Ministry of Higher Education, Science, Research and Innovation (MHESI). NANOTEC has participated and conducted various nanotechnology activities as following:

ProPak Webinar on Smart Packaging

On 17th June 2021, NANOTEC and Council of Scientific and Technological Associations of Thailand (COSTAT) joined the 29th International Processing and Packaging Exhibition for Asia (PROPAK Asia) Virtual Event to organize a seminar on “Smart Packaging”.

Maj. Gen. Dr. Chainarong Cherdchu, President of COSTAT and Chairman of Nanosafety Network for Industry, NANOTEC gave the opening remarks. The seminar topics included the following:

- “Nanotechnology and Packaging”
by Dr. Wannee Chinsirikul, Executive Director, NANOTEC
- “Status of plastic use in packaging”
by Professor Mayuree Paklamjeak, Food Packaging Expert and Advisor to the Plastics Institute of Thailand
- “Industrial standards for plastic industry: Food and Cosmetics”
by Mr. Asirawat Phothipphan, Standards Officer, Thai Industrial Standards Institute (TISI)
- “Safe use of nanomaterials in industrial setting”
by Dr. Waluree Thongkam, Senior Technical Officer, Nanosafety Alliance Section, NANOTEC.



ProPak Webinar on Smart Packaging

The 21st OECD/WPMN Meeting

During 22 – 24 June 2021, the 21st OECD/WPMN was organized virtually from Paris, France. Over 150 attendees from 30 members and observing nations were attending this meeting. Representing NANOTEC were Dr. Pavadee Aungkavattana, Deputy Executive Director, Dr. Sasitorn Aueviriyavit, Senior Researcher, Nano Environmental and Health Safety Research Team, Dr. Waluree Thongkam, Senior Technical Officer, Nanosafety Alliance Section NSA), and Mr. Ramjitti Indaraprasirt, Manager, NSA.

The aim of the meeting was to promote and develop internationally coordinated methods and strategies to identify and manage the potential risks of nanomaterials to human health and the environment via the following goals:

- International exchange and cooperation on health and environmental policies relating to manufactured nanomaterials (MNMs)
- Generating data on risk research in a large-scale testing programme (Sponsorship Program)
- Formulating proposals for the adaptation of:
 - OECD guidelines for testing chemicals
 - Sample preparation and dosimetry for safety testing
 - Strategies on risk assessment
 - Development of principles for exposure assessment

Attendees were invited to submit the Tour de Table report to provide updates on their respective national development on nanotechnologies.

The 18th Asia Nano Forum Summit 2021 (Virtual Meeting)

During 5 – 6 August 2021, NANOTEC in collaboration with the Asia Nano Forum (ANF) organized the virtual meeting of the 18th Asia Nano Forum Summit 2021 (ANFoS 2021). ANFoS is an annual meeting where representatives from all 15 of the member economies meet to update the Nanotechnology development and discuss related issues such as policy, R&D, and commercialization. In this regard, eligible ANF members voted to elect Dr. Wannee Chinsirikul, Executive Director of NANOTEC to be the President of ANF. She is the first woman to hold this position. The new team of ANF Office Bearer will last for 2 years (2022 - 2023).

In addition, two technical meetings were organized. The first one was the “Nanosafety Forum on Country Experiences and Predictive Model Development for Safety Guidelines and Standardization” organized by ANF Working Group on Nano Safety and Risk Management on 5 August 2021 in which Dr. Wannee Chinsirikul, NANOTEC, NSTDA, and Assoc. Prof. Paul Wright, RMIT University, Australia, are the working group’s coordinators. This activity gives an opportunity to exchange experiences in areas related to Nanosafety ISO/TC229 and lead to cooperation in the region.

Another side event was a sharing experiences meeting on business related to nanotechnology research. Dr. Rezal Khairi Ahmad, CEO from NanoMalaysia Berhad, Malaysia is the coordinator of the Asia Nano Forum Working Group on Commercialization, hosted the

“Workshop on Commercialization” on 6 August 2021. Both side events have brought together scientists and policy makers to realize the importance of the sustainable development of nanotechnology in the region, including research, development, and applications that have social and economic impacts.

This was the third time for NANOTEC, Thailand to host Asia Nano Forum Summit. The first time was in Phuket, in 2004, and the second was in Bangkok, in 2012. This time things were far from normal as we continue to navigate an unparalleled set of challenges resulting from the COVID-19 pandemic. The on-site meeting as well as the Thai hosting was adjusted to be 100% online meeting.



The 18th Asia Nano Forum Summit 2021

7th NanoThailand 2021

During 16 – 17 December 2021, the 7th NanoThailand 2021 was held with the research highlight in the topic of “Nanotechnology in mRNA COVID-19 Vaccine” honored by Prof. Dr. Kiat Rakruntham, Executive Director of the COVID-19 Vaccine Development Project Vaccine Research Center, Faculty of Medicine Chulalongkorn University and the topic of “Nucleoside-modified mRNA-LNP therapeutics” by Prof. Drew Weissman from the University of Pennsylvania, USA.

Dr. Wannee Chinsirikul, Executive Director of the National Nanotechnology Center (NANOTEC), NSTDA and a vice President of the Nanotechnology Association of Thailand, along with Assoc. Prof. Dr. Suvit Saetia, President of King Mongkut’s University of Technology Thonburi (KMUTT) gave opening remarks at the 7th Thailand International

Nanotechnology Conference in the topic of “The Role of Nanotechnology in Times of Disruptive Transformation”. This conference was organized by Nanotechnology Association of Thailand and the Faculty of Science, KMUTT and was held at the Bioresearch and Innovation Building (BRI) along with an online platform.



7th NanoThailand 2021

Acknowledgements

Contents of Annual Report are contributed by the following member organizations:

Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), Austria

The Energy and Resources Institute (TERI), India

Iran Nanotechnology Innovation Council (INIC), Iran

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

Japan Science and Technology Agency (JST), Japan

National Institute for Materials Science (NIMS), Japan

Korea Nano Technology Research Society (KoNTRS), Korea

NanoMalaysia Berhad (NMB), Malaysia

National Nanotechnology Centre (NNC), Malaysia

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

Institute of Physics (IOP), Academia Sinica, Taiwan

National Nanotechnology Center (NANOTEC), Thailand