Table of Contents

✧ About Asia Nano Forum

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

Mission & Objective

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

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

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

Working Groups

Standardization

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

Coordinator: Dr. Bingcheng YAO (ITRI, Taiwan)-MikeYao@itri.org.tw; Dr Ali Beitollahi (INIC, Iran) - beitolla@iust.ac.ir

Education

To inspire and train the future generation of leaders to drive nanotechnology R&D towards responsible development and sustainability of humanity
There are two flagship events in this working group namely Asia Nanotech Camp (ANC) and International Nanotechnology Olympiad (INO) which provide platform for young scientists to learn the latest nanotechnology development, forge early collaborations and addressing nano enabled innovation for solving problems related to sustainability.

Coordinator: Dr. Lerwen LIU (NanoGlobe, Singapore)- lerwen@nano-globe.biz

Infrastructure

To establish better awareness of the infrastructure available on the micro/nanofabrication and characterization facilities in the ANF community and thus promote a synergistic bridging among ANF members with interdisciplinary integration and communication.
This working group provides a platform access to R&D facilties among participating members and facilitate R&D collaborations among members.

Coordinator: Dr. Ramam AKKIPEDDI (IMRE, Singapore) -ram-akki@imre.a-star.edu.sg; Dr. Hiro Akinaga (AIST, Japan)-akinaga.hiro@aist.go.jp

Nano Safety

To co-ordinate nanosafety activities in the region through the Asia Nano Safe network, including harmonization of nano safety training, safety-by-design approach to nanotechnology development and translational nano research to the marketplace. Also, to provide a co-ordinated response for community concerns and engagement on nanotechnology safety and risk management issues.
This working group has been playing an active role in the annual International Symposium on Nanotechnology Occupational and Environmental Health (NanOEH) through offering Asia Nanosafety Award to distinguished young researchers.

Coordinator: Dr. Paul WRIGHT (Australia) -paul.wright@rmit.edu.au

Commercialization

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

Coordinator: Dr. Rezal Khairi Ahmad (NanoMalaysia, Malaysia)-rezal@nanomalaysia.com.my

Member Organizations

Advanaced Research Center International (ARCI, India)

Australian Nanotechnology Network (ANN, Australia)

Austrian Ministry for Transport, Innovation and Technology (BMVIT)

Department of Industry, Innovation and Science (DIIS, Australia)

Hong Kong University of Science and Technology (HKUST, Hong Kong)

Indonesian Institute of Sciences (LIPI, Indonesia)

Innovation and Application of Nanoscience Thematic Program (IANTP, Taiwan)

Institute of Materials Research & Engineering (IMRE, Singapore)

Iranian Nanotechnology Initiative Council (INIC, Iran)

Japan Science and Technology Agency (JST, Japan)

Khalifa University of Science, Technology & Research (KUSTAR, UAE)

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

Korean Nanotechnology Researchers Society (KoNTRS, South Korea)

MacDiarmid Institute for Advanced Materials and Nanotechnology (MacDiarmid Institute, New Zealand)

Nano Malaysia (Malaysia)

National Institute for Materials Science (NIMS, Japan)

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

National Nanotechnology Center (NANOTEC, Thailand)

National Nanotechnology Directorate (NND, Malaysia)

Peking University (PU, China)

Suzhou Nanotech (Nanopolis, China)

Vietnam Academy of Science and Technology (VAST, Vietnam)

Asia Nano Forum Office Bearers (2016– 2017)

President
Ramam AKKIPEDDI
(IMRE-A*STAR, Singapore)

Vice President
Junichi SONE
(JST, Japan)

Vice President
Ali BEITOLLAHI
(INIC, Iran)

Founding Secretary
Lerwen LIU
(NanoGlobe, Singapore)

Vice President
Rezal Khairi AHMAD
(Nano Malaysia, Malaysia)

Secretary
T.K. LEE
(Academia Sinica, Taiwan)

Asia Nano Forum Executive Committee (2016)

Werasak SURAREUNGCHAI
(KMUTT, Thailand)

Chung Yu WU
(NCTU, Taiwan)

Chennupati JAGADISH
(ANN & ANU, Australia)

Takahiro FUJITA
(NIMS, Japan)

Kyung-ho SHIN
(KoNTRS, South Korea)

Sirasak TEPARKUM
(NANOTEC, Thailand)

Alexander POGANY
(BMVIT, Austria)

Toshihiko KANAYAMA
(AIST, Japan)

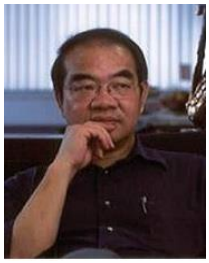
Abdul Kadi Masrom
(NND, Malaysia)

Tran Dai LAM
(VAST, Vietnam)

Nurul Taufiqu ROCHMAN
(LIPI, Indonesia)

Asia Nano Forum Former Presidents

Founding Chairman
Kazunobu TANAKA
(JST & AIST, Japan)



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

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

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

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

Other Founding Members

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

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

Venkatesh Rao AIYAGARI
India

Jane NIALL
Australia

Hong Khoi PHAN
Vietnam

Wiwut TANTHAPANICHAKOON
Thailand

Halimaton HAMDAN
Malaysia

✧ Greetings from ANF Secretariat, Singapore

Dear ANF members,

Greetings! We are pleased to present you another issue of ANF Annual Report 2016 edited based on the 3 ANF newsletters published between Sept. 2015-Jun. 2016. It covers our usual topics including Research Breakthroughs, Commercialization, Education/Research Programs, and Partnerships/Collaborations. We see consistently strong support from members in Iran, Malaysia, Taiwan and Thailand providing us with very interesting information to share, moderate support from other members.

We are very excited to welcome 2 new members who recently joined us this year, namely Japan Science and Technology Agency (JST) and King Mongkut's University of Technology Thonburi (KMUTT). Please read this report to learn more about their amazing work in nanotechnology.

We have recently upgraded our website which is now much more appealing and professional. We will continue to improve our outreach efforts. We are very much in need of your help and support on how to improve ANF network members' nanotechnology information dissemination. ANF provides a unique platform for collaborations in various activities in the field of nanotechnology as well as marketing. We hope all of us could take advantage of this platform and benefit from it. From this annual report, you may find 2 issues of our Asia Nanotech Camp (2015 & 2016) special editions highlighting the flagship activities of the Education Group. We look forward to having contribution from other working group in our next year's annual report.

I very much look forward to productive discussions with you during the ANF summit 2016 in Seoul!

Lerwen

Lerwen LIU

Founding Secretary of Asia Nano Forum on Behalf of the Secretariat Office in Singapore

Email: lerwen@nano-globe.biz

✧ NEWS

Partnership/Collaboration

Taiwan (Source: The Innovation and Application of Nanoscience Thematic Program (IANTP)

(1) Taiwan participates in the M-ERA.NET

Dr. Ting-Kuo Lee, as one of the board members representing MOST, attended the working group meeting and steering board meeting of M-ERA.NET consortium on September 14 in Warsaw, Poland. The main issue discussed in the meeting is to finalize the list of pre-proposals of Joint Call 2015. There are 2 proposals involving Taiwan partners recommended for proceeding to full proposals. On Sept. 15, M-ERA.NET conference has six talks presented by on-going projects funded under the M-ERA.NET scheme. The first talk was given by Professor Wei-Fang Su from National Taiwan University. She leads the project to use her materials for sensing special molecules, which is making progress. After the talks, there was a panel discussion and the six speakers were asked about their experience with international cooperation in general and the M-ERA.NET scheme in particular. One important function for this kind of program is to have students/postdocs from Taiwan team to visit collaborators to learn from them.

(2) 2015 Joint US-Korea-Taiwan Nanoscience Program Review and Technical Exchange

Each year the Asian Office of Aerospace Research and Development / US Air Force Office of Scientific Research (AOARD/AFOSR) holds annual program review for US-Korea Nano Bio Info Technology and USAF-Taiwan Nanoscience Programs. To Further international collaboration, Korea, Taiwan, and the US have decided to hold joint programs reviews in 2015 and 2016. The Korean National Research Foundation (NRF) has graciously hosted this year's review in Seoul, South Korea on 26-30 October 2015. More than 50 scholars and experts participated this event, and most of them gave a presentation. Next year this tri-nation program review and technical exchange will be held in Taiwan.

(3) Taiwan participates in the M-ERA.NET

Dr. Wen-Chang Hsu, representative of National/Regional funding organization of Taiwan, the Ministry of Science and Technology (MOST) has attended the M-ERA.NET Call 2015 Selection Meeting and the Kickoff Meeting which were held on 26-27 January 2016 in Vienna, Austria. The main issue discussed in the first part of the event is to finalize the list of full proposals of Joint Call 2015. There are only 20 recommended for funding within 54 passed full-proposals (39 failed). A full - proposal from National Chung Hsing University of Taiwan has been recommended for funding. The second part of the event refers to the M-ERA.NET 2 (2016 – 2021) which is a continuation of M-ERA.NET beyond FP7 and kicks off with 41 public national and regional funding organizations in 25 countries. It kicks off with 41 public national and regional funding organizations in 25 countries. There are 6 themes for M-ERA.NET2 Call 2016, including "Integrated computational materials engineering", "Innovative surfaces, coatings and interfaces", "High performance synthetic and biobased composites", "Functional materials", "Interfaces between materials and biological hosts for health applications" and "Materials for additive manufacturing". Deadline for submission of pre-proposals is 14 June 2016. Afterward there will be a Consensus Meeting for Pre-proposals 2016 in September.

(4) Taiwan held the 12th Cross-Strait Workshop on Nano Science and Technology

The 12th Cross-Strait Workshop on Nano Science and Technology (CSWNST-12) was held at Academia Sinica, Taiwan on 22-25 March 2016. The program consisted of 3 invited presentations, 80 oral presentations, and 18 poster presentations. More than 100 scholars and experts from Taiwan, China, and Hong Kong participated this event to share their work as presentations or posters. The seven conference topics this year include "Applications of Nanoscience and Nanotechnology: Biological and Biomedical", "Applications of Nanoscience and Nanotechnology: Energy, Environment & Catalyst", "Applications of Nanoscience and Nanotechnology: Optoelectronics and Electronics", "Characterization, Manipulation, and Standardization of Nanomaterials and Nanostructures", "Fabrication and Mass Production of Nanomaterials and Nanostructures", "Functionalization, Assembling, and Integration of Nanomaterials", and "Theoretical Modeling, Computation and Simulation in the Above Areas".

(5) Young scientists from Taiwan participated in the 9th Asia Nanotech Camp 2016 (ANC2016)

The 9th Asia Nanotech Camp 2016 (ANC2016) hosted by the Austrian Ministry for Transport, Innovation and Technology in cooperation with the Austrian Academy of Science and the IMC University of Applied Sciences Krems, was held on 3-8 April 2016 in Krems, Austria. This program aimed for young nanotechnology PhD students and early career researchers (within 3 years of their PhD graduation) to learn about the cutting-edge nanotech advancements, risk, responsibilities and sustainability. A workshop began with an introduction to the topic of "Safe and Sustainable Development of Nanotechnologies and Responsible Innovation Towards Sustainability". Well-known speakers from Asia and Europe presented concepts and perspectives in the field of nanosafety and nano risk governance with special emphasis on differences between Asia and Europe. Then there was an international conference of BioNanoMed following the workshop. Among the outstanding keynote speakers, Prof. Arben Merkoci from ICREA, Spain gave an inspiring presentation on development of biosensors such as DNA sensors and Immunosensors. There is a total of 24 participants from 11 countries, including Japan, Taiwan, Thailand, Malaysia, China, South Korea, Singapore, Iran, Hong Kong, Vietnam and Austria this year.

(6) Taiwan-Malaysia NanoMark/NANOVerify Programs Workshop in Taiwan

Taiwan-Malaysia NanoMark/NANO*Verify* Programs Workshop was hosted by Taiwan Nanotechnology Industry Development Association (TANIDA) on 12 April 2016 in Taipei, Taiwan. As pioneer countries in promoting nano-certification in the world, Taiwan and Malaysia have already established the voluntary certification of nanoMark and NANO*Verify* respectively. Therefore, a certification network of nanoproducts is expected to be developed. Delegation from Malaysia was led by Dr. Rezal Khairi Ahmad, CEO of NanoMalaysia Berhad. There was a signing ceremony of the Memorandum of Understanding (MOU) between TANIDA and NanoMalaysia Berhad prior to the workshop. Both parties agree to encourage and promote cooperation in the field of mutual recognition on nano products certification and nanotechnology commercialization. The discussed topics during the workshop include "NanoMark Program General Process and Sstatus", "NanoMark Standards Status and Case Study", "NanoMark Testing Laboratories", "NANO*Verify* Programme Overview and Status", "NANO*Verify* General Process", and "NANO*Verify* Testing Laboratories".

Malaysia (Source: Nano Malaysia)

(1) NANO- SCITECH 2016

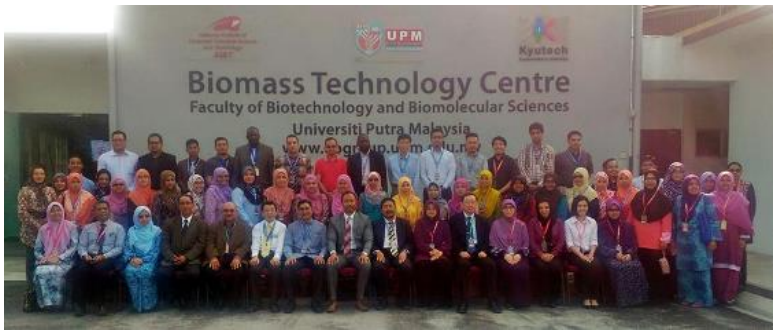
SHAH ALAM, 27TH FEBRUARY 2016 – International Seminar on Nanoscience and Nanotechnology 2016 (Nano-SciTech 2016) was held at the Institute Of Leadership and Development (ILD), UiTM Shah Alam.

Chief Executive Officer of NanoMalaysia, Dr. Rezal Khairi Ahmad gave an in depth understanding on commercialisation of nanotechnology to the participants at the seminar.

NANO-SciTech 2016 was organised by NANO-SciTech Centre, Institute of Science, Universiti Teknologi MARA (UiTM) with UiTM-NITech Liaison Office, Nagoya Institute of Technology (NITech), Nagoya, Japan and National Institute of Technology, Kagawa College, Kagawa-Ken, Japan as co-organisers. The scientific objective of this conference was to stimulate the interest of academicians and researchers in the Nanoscience, Nanotechnology and Nano-engineering field by providing a platform for necessary linkages and interaction involving participants from different regions over the world.

(2) NANOCELLULOSE WORKSHOP 2016

SERDANG, 21ST MARCH 2016 – Workshop on Nanocellulose Material: From Fundamental to Applications was held at Biomass Technology Centre, Universiti Putra Malaysia (UPM), Serdang. This workshop was organised by Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia.



The participants were given the insight on theoretical and technical aspects of nanocellulose fibres including on nanocellulose potential in Malaysia which was shared by Dr. Rezal Khairi Ahmad, Chief Executive Officer of NanoMalaysia.

Australia (Source: Australian Nanotechnology Network (ANN))

Another successful International Conference on Nanoscience and Nanotechnology (ICONN 2016) hosted by the Australian Nanotechnology Network was held in Canberra in February 2016.

ICONN2016 attracted six hundred delegates from nineteen countries and was chaired by Prof Chennupati Jagadish and Prof Hoe Tan from the Australian National University.

A short course on the Introduction to Nanofabrication Technologies was held on the first day, was organised by, and featured speakers from the Australian National Fabrication facility.

8 Plenary speakers including Nobel Laureate, Prof W E Moerner and thirty six invited speakers gave a remarkable synopsis of recent developments in the field.

More information on this year's program, conference themes, symposia chairs and co-chairs can be accessed on the following http://www.ausnano.net/iconn2016/

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

NANOTEC and AIST have had many collective researches in Nanotechnology field. This program targets to inherit this achievement for the next generation and to promote more exchanges. Furthermore, this program have more important goal to cultivate human

resources capable of contributing research result to developments of societies in both countries. The researchers from NANOTEC had technical trainings with state-of-the-art and highest level facilities for 10 days in AIST. The technical trainings were Ultrafine Fabrication Process Course in Super Clean Room and Micro Electro Mechanical systems (MEMS). During their stay, they had events such as a meeting on nanotechnology with AIST researchers, visited NIMS and Rigaku corp., participated in International Nanotechnology Exhibition and Conference, "Nanotech 2016". Plus, they joined an exchange program of Nanotech CUPAL and had exchanges with Japanese young researchers. AIST would like to continue this program and deepen much more research exchange with Thailand.

Thailand (Source: National Nanotechnology Centre (NANOTEC))

(1) Royal visit at Synchrotron Light Research Center

Synchrotron Light Research Center (SLRI) welcomed HRH Princess Maha Chakri Sirindhorn to the Royal Opening Ceremony of "Macromolecular Crystallography Beamline". As part of the opening ceremony program, the Ministry of Science and Technology and NANOTEC provided update on the BL5.2 (SUT-NANOTEC-SLRI Joint Research Facilities for Synchrotron Utilization') collaboration project to HRH. The aim of the project is to provide infrastructure facility to researchers for the studies of atomic arrangement and elemental speciation of material. BL5.2 is a consortium beamline, jointly funded by Suranaree University of Technology, the National Nanotechnology Center and SLRI.

(2) NANOTEC and NECTEC mobilize to install nano filtration water unit at a local hospital (July 27)

Representatives from NANOTEC and NECTEC mobilize to install a nano filtration water unit (SOS V2) at Chandarubeksa Hospital in Kamphaeng Saen, Nankorn Pathom province for use at their staff housing facility. The housing unit currently receives water from an in-house water treatment facility operated by the hospital. The SOS V2 unit will help to eliminate the problem associated with water color, odor, and existence of heavy metal in the water supply which is a constant nagging problem for the hospital during the dry season.

The RTAF which oversees the operation of 10 hospitals in Thailand including Chandarubeksa will explore the possibility of installing additional SOS V2 units in other RTAF hospitals.

SOS V2 nano filtration unit is a result of research collaboration between NANOTEC and NECTEC. It is designed to use 2 nano filtration process (carbon nano and silver ceramic nano filter) for anti-bacterial functions and operated by embedded control system developed by NECTEC. The unit is capable of producing 300 liters of clean drinkable water per hour from wells and/or surface water ponds.

(3) Plasmonic Bio-sensor for detecting serious diseases in SE Asia

NIMS (Japan), IMS (Vietnam), and NANOTEC (Thailand) organized the symposium on "Plasmonic Bio-sensor for detecting serious diseases in SE Asia" at Thailand Science Park.

The NANOTEC-NIMS-IMS Research project entitled "Plasmonic Bio-sensor for detecting serious diseases in SE Asia" began in 2012 and is under the e-Asia Joint Research Program (e-Asia JRP).

The project was successful in utilizing bio-sensors technology to detect a serious infectious disease (Influenza A H1N1). The symposium marks the conclusion of Phase 1 of the project. Discussion to continue the project is on-going at present.

(4) Use of Slow Release Fertilizer at Royal Park Rajapruek in Chiang Mai

NANOTEC and Royal Park Rajapruek in Chiang Mai organized an official handover of Slow Release Fertilizer for use in the "Shaded Paradise" greenhouse facility this morning.

The Smart Soil and Fertilizer Flagship at NANOTEC developed and produced fertilizer formulations for controlled release of nutrients for crops, using polymer materials made from naturally porous and nano-sized particles (considered as nano-organic chemical). The amount and duration of release of nutrients can be controlled and optimized for particular plants. The duration of the release can be as much as 3-6 months, depending on the type of crop it is being use for. The polymer coatings were formed by the phase inversion technique. The thickness and porosity and physical properties of the coatings influence the release rate of nutrients which are present in the core of the coated fertilizers.

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

Nano@KMUTT Hosted Three Renowned Nanotechnologists (Bangkok, Thailand)

Nano@KMUTT had unique opportunities to welcome three prominent scientists from around the world. In 2015, Professor Pulickel Ajayan, a pioneer in the field of carbon nanotubes from Rice University (USA), came to share with us his current research activities in his talk "Material Science of 2D Atomic Layer." Later in the same year, we were fortunate to have with us Dr. Lerwin Liu, Managing Director of NanoGlobe and founding ANF Secretary. Dr. Liu highlighted the latest developments in nanotech start-up as well as nano educational programs in Asia. Lastly, during his visit in Feburary 2016, Proferror Nadrian Seeman from New York University gave a talk on the topic of "DNA: Not Merely the Secret of Life," summarizing his entire career to become the world-leading researcher in DNA nanotechnology.


Singapore (Source: Institute of Materials Research & Engineering (IMRE) http://www.imre.a-star.edu.sg/)

(1) Engineering the future of thermoplastics

In photo: (seated, from left to right) IMRE's Dr Chi Dongzhi, Head, Design and Growth, signed the RCA with Dr Suracha Udomsak, R&D Director, SCG Chemicals. Witnessing the signing are: (standing, from left to right) Dr Wilaiporn Chetanachan, Director of Corporate Technology Office, SCG; Prof Hardy Chan,IMRE EXCO member; Mr Kan Trakulhoon, Director and Chairman of the Management Advisory Committee and Mr Yuttana Jiamtragan, Vice President, Corporate Administration, SCG. R&D Director, SCG Chemicals. Witnessing the signing are: (standing, from left to right) Dr Wilaiporn Chetanachan, Director of Corporate Technology Office, SCG; Prof Hardy Chan,IMRE EXCO member; Mr Kan Trakulhoon, Director and Chairman of the Management Advisory Committee and Mr Yuttana Jiamtragan, Vice President, Corporate Administration, SCG.

One of the biggest polyolefin producers in Thailand, Siam Cement Group (SCG) Chemicals, signed two Research Collaboration Agreements (RCA) with IMRE, to further develop the

technology in polyolefin composite materials. SCG Chemicals will be working closely with IMRE's research team on two projects - High strength and tough polyolefin composite/ High strength reinforced polyolefin composite.

Existing manufacturing capabilities are too costly for production/extrusion of polyolefin. IMRE scientists have discovered an optimal mix of materials to form a polyolefin composite that is more cost effective and efficient while being readily extruded for industrial use.

This collaboration with SCG Chemicals could potentially open a new dimension for polyolefin composite industries by replacing engineering plastics with polyolefin. The advantages of reinforced polyolefin over other engineering plastics are: light weight, low cost, and ease of resin modification. Target applications include the interior of automotive and aircrafts, building construction materials and infrastructure materials such as pipes.

(2) Exploring new frontiers at Molecular Materials Meeting (M3)

(From left): Prof Andy Hor, Executive Director of IMRE (Jun 2010- Aug 2015) and Mr Lim Chuan Poh, A*STAR Chairman, hosted His Excellency Haruhisa Takeuchi, Ambassador of Japan to Singapore; and Dr Yoichiro Matsumoto, Executive Director of RIKEN

"Science is without borders. It is on the strength of the mutual trust and confidence between the research communities that enduring and impactful strategic partnerships are forged and successful collaborations seeded," said Mr Lim Chuan Poh, Chairman, A*STAR, during his welcome speech for 5th Molecular Materials Meeting (M3).

M3 was a borderless scientific event as distinguished speakers and global scientific leaders from 25 countries shared latest developments in molecular materials. There were six parallel sessions, in addition to plenary talks.

M3's theme this year was "The Next 50 Years in Materials Re-search", to commemorate Singapore's Golden Jubilee. The fifth M3 attracted the highest number of participants, with more than 300 of them from outside of IMRE.

Two key events at M3 were the Asia Nano Forum and A*STAR-RIKEN Joint Symposium. This year also marks the 10th anniversary of A*STAR's and RIKEN's Science and Technology partnership.

"Molecular-materials research can affect everyday lives tremendously in the most fundamental ways. Thus, we have every reason to look forward to the next 50 years of national development and materials innovation," said Pr of Hor.

M3's first CTO forum, on the second day, provided the plat-form for intimate discussions about encouraging innovations in the private, public and academic sectors. There was also an industry fair for commercial partners.

At the end of three intellectually stimulating days, prizes for "Best Poster" and the inaugural Lubrizol Young Materials Science Investigator award were given out.

Commercialization

Taiwan (Source: The Innovation and Application of Nanoscience Thematic Program (IANTP))

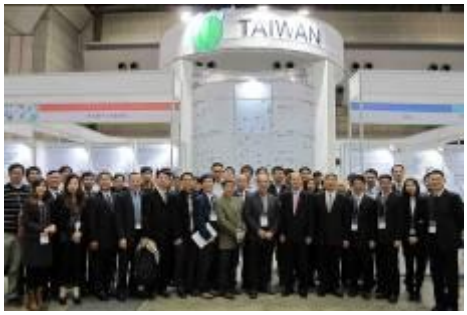
(1) NanoMark Program, MOEA

The nanoMark enhances the overall enterprise competitiveness. The nanoMark has been promoted for 10 years and has cumulative fruitful results. From 2004 to date, 52 certification specifications have been set up. At the same time, there are already 44 companies, 2355 products that passed the nanoMark certification. More than 90% of the products are building materials. The results of a market research indicated that not only can the nanoMark help the companies who have passed the nanoMark certification increase their "corporate image", gain customers' confidence and promote "market sales", it can even increase the selling price of their products by 20%.

(2) ISO/TC 229 Working Group Meetings

ISO Nanotechnology Committee (The International Organization for Standardization (ISO) Technical Committee (TC) 229 on Nanotechnologies, ISO/TC 229) was established in 2005 and has been developing standards related to the field of nanotechnologies. The ISO/TC 229 Working Group Meetings were held this year on Sep. 28 - Oct. 02 in Edmonton, Canada. On behalf of ANF (liaison member of ISO/TC 229), Taiwan attended the ISO/TC 229 meetings and participated in the working groups of "Terminology and nomenclature", "Measurement and characterization", "Health, Safety and Environmental Aspects of Nanotechnologies", and "Material specifications" to discuss the global nanotechnology standards and Environment, Health and Safety (EHS) development. With this standard platform, Taiwan can share the experience of nanoMark program with other members and bring domestic industries the latest international standard policy or regulation.

(3) Taiwan Pavilion in nano tech 2016, Japan



"Nano tech 2016 – the 15th International Nanotechnology Exhibition & Conference" was held on 27-29 January 2016 in Tokyo, Japan. Taiwan Pavilion has been participating this event for 12 consecutive years. " Japan Nanotech 2016 Taiwan Pavilion Project, MOST" elected 31 technology and research achievements from 27 industry, academia, and research units to demonstrate Taiwan's latest nanotechnology status. Representative of Taipei Economic and Cultural Representative Office in Japan, Ssu-Tsun Shen, and staff visited Taiwan Pavilion during the exhibition. This year Taiwan Pavilion won the "Continuous Achievement Award", which represents Taiwan's continuous contributions and efforts to the development of nanotechnology. During the world's largest nanotechnology event, Japan's Nanotechnology Business Creation Initiative (NBCI) hosted the 8th Nanotech Association Conference in conjunction with the exhibition as usual. About 25 experts from Canada, Germany, Japan, Netherlands, Singapore, Taiwan and USA participated in the discussion and exchange of current development of nanotechnology. In Taiwan's presentation, the nanoMark program is the issue all countries are interested in.

Malaysia (Source: Nano Malaysia)

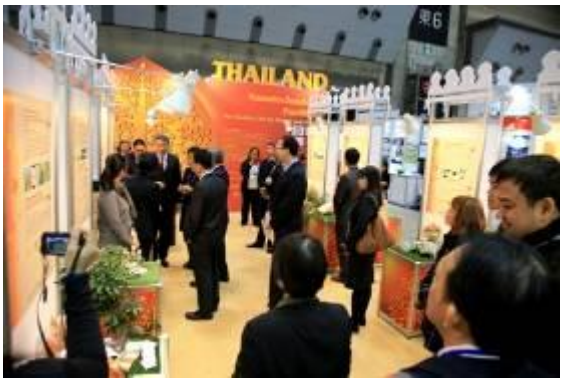
(1) NanoMalaysia-Tanida Signed & Exchanged MOU on Nanotechnology Development and Commercialization

TAIWAN, 12TH APRIL 2016 - Dr. Rezal Khairi Ahmad, Chief Executive Officer of NanoMalaysia and Prof. Chung-Yu (Peter) Wu, Chairman of Taiwan Nanotechnology Industrialization Promotion Association (TANIDA) signed a Memorandum of Understanding on nanotechnology product development, commercialization and mutual acceptance on NANO*Verify* Programme implementation.

Thailand (Source: National Nanotechnology Centre (NANOTEC))

The 15th International Nanotechnology Exhibition and Conference on 26-30 January 2016 at Tokyo Big Sight, Tokyo, Japan

The 15th International Nanotechnology Exhibition and Conference is 6th year that Thailand have participated in what is considered "the world's largest event for nanotechnologies". A total of 16 exhibitions by both private sectors and research agencies under the theme "Nanotechnology in Thailand: For Healthy Life by Nature and Green" at Thailand Pavilion. The Thai delegation consisted of representatives from 5 companies and 5 products, namely, NANO ANTI BACTERIA WIPES from KEEEN Ltd., Controlled Release Fertilizer from Smart Vet Co., Ltd., The aromas from Thai Techno Glass Co., Ltd., Antibacterial Fine Powder from IRPC and Mouthwash and mouth spray from Greater Pharma and researchers from NANOTEC, TISTR, and TRF. Leading the Thai delegation was Prof. Pairash Thajchayapong, Chairman of NANOTEC Executive Board and Prof. Sirirurg Songsivilai, Executive Director of NANOTEC. In addition, the Thai delegates were involved in one-on-one business matching activities, attending technical seminars, and building networking opportunities for business and research collaborations. Over 50,000 visitors from 23 countries were participating in this mega event.



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

Quasense's Two Latest Developments (Bangkok, Thailand)

Quasense (http://www.quasense.co.th/), a spin-off led by Werasak Surareungchai, a scientist from nano@KMUTT, has established itself as a regional manufacturer of screen-printed electrodes for both commercial and academic applications. The symbiotic relationship results in continual technological transfer between the company, nano@KMUTT, and other partners.

One of the outcomes of this lively engagement is Capsella, a detector of capsaicinoid compounds – US patent 8945370 B2, which causes burning

sensation in spicy food. The machine helps food industries standardize spiciness by replacing human's subjective gustatory perception. This product won a gold medal from 2015 Taipei International Invention Show & Technomart.

By August this year, a new product from Quasense—a 16-channel potentiostat—will be released. This is a product from a fruitful business partnership started in Late 2015 between Quasense and Huasense, an expert in electrochemical instrumentation from Hanzhou, China.

New Education/Research Programs

Thailand (Source: National Nanotechnology Centre (NANOTEC))

Awards

Five NANOTEC researchers who have received two big and important awards: The 2015 Office of the National Research Council of Thailand (NRCT) Excellence Research Award and the 2016 Thailand Research Fund (TRF) for Yong Research.

The 2015 Office of the National Research Council of Thailand (NRCT) Excellence Research Award:

1. Dr. Teerapong Yata, researcher from Nano Delivery System Laboratory (NDS) for Excellence thesis entitled "Bacteriophage: from bacteria to Targeted Gene Delivery to Mammalian cells"

2. The NANOTEC team lead by Dr. Nawin Viriyaempikul for their research on using modern catalysis from waste eggshell for biodiesel production.

The 2016 Thailand Research Fund (TRF) for Yong Research. Three researchers are consisted of

3. Dr. Noppadol Aroonyadet, Nano structures and Functional Assembly Laboratory (NFA), research entitled "Development of Highly Sensitive Top-Down Fabricated Indium Oxide Nanoribbon Field Effect Transistor Biosensor Chips with Integrated the on-Chip Gate for Early Disease Diagnosis and Prognosis"

4. Dr. Katawut Namdee, Nano Delivery System Laboratory (NDS), research project entitled "Multifunctional Alginate Microfiber for Cell Encapsulation based on dual control release alginatelyase and Basic Fibroblast Growth Factor Nanoparticles"

5. Sineenart Thaiboonrod, Nanoengineered Soft Materials for Green Environment Laboratory (SOF), research entitled "A Novel preparation of poly (2-aminoethyl methacrylate hydrochloride) nanoparticles via one step reaction and engineering their surface structure"

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

Nanoscience and Nanotechnology Graduate Program at KMUTT (Bangkok, Thailand)

KMUTT has just launched a new international academic program offering master's and doctoral degrees. The program aims to nurture the new generation of researchers in nanotechnology. It is run by a team of vibrant investigators from around KMUTT. Its diverse working environment leads to multidisciplinary research including, but not limited to, smart nanomaterials, flexible

nanoelectronics, DNA nanotechnology, photovoltaics, and point-of-care diagnostics. Students in the program will have research opportunities overseas with our international network partners as well as internships with regional industries. Full financial support is available for all qualified candidates. Please contact nano@kmutt.ac.th for more information.

Japan (Source: National Institute of Advanced Industrial Science and Technology (AIST) - http://www.aist.go.jp/index_en.html)

(1) Science and technology exchanges with young researchers who will lead the next generation nanotechnology field in Thailand.

—"Japan-Asia Youth Exchange Program in Science" (SAKURA Exchange Program in Science)

Completion certificate ceremony for SAKURA Exchange Program in Science

(2) Technical training to young researchers

National Institute of Advanced Industrial Science and Technology (AIST) in Japan conducted a technical training to young generation researchers of National Nanotechnology Center (NANOTEC) in Thailand.

10 researchers from NANOTEC visited AIST for training organized by Japan Science and Technology Agency, "Japan-Asia Youth Exchange Program in Science" (SAKURA Exchange Program in Science) from Jan.11 to Jan.30, 2016.

Technical training in AIST

General News

Taiwan (Source: The Innovation and Application of Nanoscience Thematic Program (IANTP))

IANTP Call for Proposal 2016

Through the initiation of Call-for-Proposal 2016, Taiwan's Innovation and Application of Nanoscience Thematic Program (IANTP) encourages scholars to engage in translational research based on scientific discoveries, from a basic Technology Readiness Level (TRL) of "Concept Development" to a more advanced "Prototype Validation", to produce original nanomaterials, components/devices and technology, and to meet the societal needs and to strengthen the industry competitiveness. IANTP focuses on 4 key areas, including "Nanomedicine and Biotechnology", "Nanomaterials for Energy and Environment", "Nanoelectronics and Optoelectronics" and "Fabrication, Characterization and Mechanics of Nanostructures". The majority of submitted proposals this year are relevant to biomedicine just like last year. The funding list of full-proposal will be finalized by the Ministry of Science and Technology in late May 2016. Innovation of technology development and feasibility of marketable application are the main criteria of the review.

Malaysia (Source: Nano Malaysia)

NGAP 2020 MOU EXCHANGE CEREMONY

PUTRAJAYA, 3RD MARCH 2016 - National Graphene Action Plan 2020 (NGAP 2020) collaborating companies exchanged MoUs to cooperate and to take joint efforts in sharing positive insights, initiatives and implementations of collaborative projects aimed at enhancing downstream application of graphene relevant to Malaysia. This will eventually enable a local graphene eco-system to

accelerate downstream adoption. These collaborations were projected to contribute RM 10 Billion towards Malaysia's GDP and estimated to contribute RM 20 Billion of GNI impact. In addition, about 9,000 jobs could be created with about 2,000 – 3,000 high-value jobs. Specifically, the collaborations involve downstream graphene-based application development for specialty and consumer products ranging from rubber additives, ultracapacitor, conductive inks and plastic additives.

"The year 2016 is the Malaysia Commercialisation Year and the Ministry of Science, Technology and Innovation (MOSTI) is trusted to elevate the commercialisation of innovative products. NGAP 2020 is realising the plan by strategically applying open innovation with inclusive innovation initiatives into the 10 projects. The 360 new products to be commercialised by 2020 are now being realise through the kick-off of the 10 projects conducted by these companies under NGAP 2020. Therefore, it is important to optimise resources and collaborate with other agencies and ministries in this area to realise our vision and mission. I hope through this initiative it will uplift the economy of the country towards a high income nation though science, technology and innovation." stressed YB Datuk Seri Panglima Madius Tangau, the Minister of Science, Technology and Innovation.

NanoMalaysia Berhad as the Agency under the Ministry of Science, technology and Innovation (MOSTI) and as the Lead Agency to execute the National Graphene Action Plan 2020 (NGAP 2020) exchanged 10 Memorandums of Understanding (MoUs) today with 10 companies under the NGAP 2020 programme at Dewan Banquette, Pejabat Utama Perdana Menteri, Putrajaya. Datuk Seri Panglima Madius Tangau, the Minister of Science, Technology and Innovation together with YBhg. Dato' Dr. Mohd Azhar Hj. Yahaya, Deputy Secretary General (Policy) of MOSTI, YBhg. Dato' Sri Idris Jala, the Chief Executive Officer of Performance Management and Delivery Unit (PEMANDU) and Prof. Emeritus Dato' Ir. Dr. Zawawi Ismail, Chairman of NanoMalaysia witnessed the exchange of the MoUs. The MoUs exchanged were to signify the embarking of 10 graphene-based product development, graphene-based prototype and graphene-based scale up production by the 10 companies under the action plan.

Thailand (Source: National Nanotechnology Centre (NANOTEC))

(1) NANOTEC Smart Health showcase at Medi Thai Fair

NANOTEC Smart Health Flagship showcase 2 research projects: INSpectDX (Smart Solution for Cervical Cancer Diagnosis) and Automated Clinical Analyzer (robotic screening and diagnosis for cervical cancer) at Medi Thai Fair which is being held from August 18-20 at IMPACT Forum, Muang Thong Thani.

Presiding at the Opening Ceremony was Prime Minister General Prayuth Chan-ocha and former Deputy Prime Minister Prof. Dr. Yongyuth Yuthavong.

(2) NANOTEC represented at ICCM4

Prof. Sirirurg Songsivilai, Executive Director of NANOTEC and Dr. Sirasak Teparkum, Deputy Executive Director represented NANOTEC at the 4th Session of the International Conference on Chemicals Management (ICCM4) meeting which began today in Geneva, Switzerland. ICCM-4 is organized by UNEP's Strategic Approach to International Chemicals Management (SAICM) and will conclude on 2 October.

The ICCM-4 program also included a nano related side event where Dr. Sirasak gave a presentation on the outcome of the recent Technical Workshop for the Asia-Pacific Region on Nanotechnology and Manufactured Nanomaterials:

Safety Issues which was held at Thailand Science Park on 10 & 11 September 2015. Both Prof. Sirirurg and Dr. Sirasak will also join the resolution discussion on "Emerging policy issues and other issues of concern"

ICCM brings together stakeholders and sectors that include agriculture, environment, health, industry, labour, economics, science and academia to catalyse achievement of the goal by 2020 "that chemicals are used and produced in ways that minimize adverse effects on human health and the environment."

(3) Nanosafety Workshop in Thailand

Participants from 11 nations gathered this morning at Sirindhorn Science Home, Thailand Science Park to participate in the 2 days' workshop on "Technical Workshop for the Asia-Pacific Region on Nanotechnology and Manufactured Nanomaterials: safety Issues". The closed door workshop is being hosted by NANOTEC, UNITAR, OECD, and Swiss Confederation.

The workshop aims to disseminate knowledge of nanotechnology and nanosafety, share experiences/lesson learned, strengthen regional networking, and explore opportunities for nanosafety programs initiations between participating countries.

(4) B-Fresh awarded the Most Interesting Technology for Investment

Dr. Gamolwan Tumcharern, a researcher at NANOTEC at Functional Nanomaterials and Interfaces Laboratory (FNI) received the Most Interesting Technology for Investment Award for her "B-Fresh" technology business pitch at NSTDA Investors' Day 2015 (NID2015).

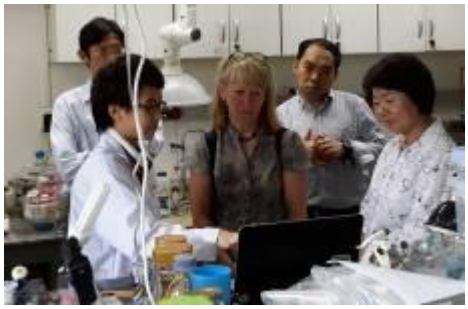
"B-Fresh" is which is added inside freshly baked bread packages to extend the shelf life and slow the progress of microorganizsm growth which causes the development of mould on bread.

According to bakery shop owners, by being able to extend the shelf life of fresh bread will help increase profit and limit waste to the store owner.

(5) 15th of the Working Party on Manufactured Nanomaterials (WPMN), Organisation for Economic Co-operation and Development (OECD) Meeting

NANOTEC participated in the 3 days of 15th WPMN meeting in Paris on November 1, 2015. The meeting focused on development of nanotechnology and nanomaterials, resources support, and challenges related to safety of manufactured nanomaterials. A presentation on Thailand's nanotechnology development was presented at the meeting.

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



A Nano@KMUTT Research Facility Welcomed KMUTT's International Advisory Panel (Bangkok, Thailand)

KMUTT inaugurated the first international research advisory panel meeting to enhance the quality, impact, and visibility of the university. Among the reviewers are Professor Geraldine Richmond, the president of AAAS, and Professor Supapan Seraphin from

University of Arizona. Our sensor technology laboratory, a part of nano@KMUTT, participated in this review from August 3–5, 2015. According to the meeting report, the laboratory has performed an “excellent combination of basic and applied research” with a “good sense of frontier areas and the areas where they can be competitive” resulting in their “excellent publications” and “excellent collaborations.” On academic staff, the reviewers mentioned that we have an “excellent professor who could be at any university in the world,” who is “lively with diverse graduate students and young researchers.” Our laboratory is at the top rank among five groups under the same category.

✧ RESEARCH BREAKTHROUGHS

Taiwan (Source: The Innovation and Application of Nanoscience Thematic Program (IANTP))

Aluminum Plasmonic Multicolor Meta-Hologram

Yao-Wei Huang, Wei Ting Chen, Wei-Yi Tsai, Pin Chieh Wu, Chih-Ming Wang, Greg Sun, and Din Ping Tsai*, *Nano Lett.* **15(5)**, 3122 (2015)

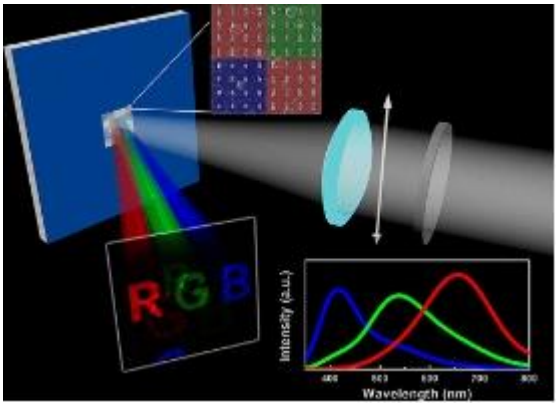


Fig. Illustration of the designed multicolor meta-hologram (MCMH) under linearly polarized illumination. The MCMH structure is made of a pixel array consisting of aluminum nanorods that produce images R, G, and B in 405, 532, and 658 nm, respectively. The pixels are patterned on a 30 nm thick SiO_2 spacer sputtered on an aluminum mirror.

We report a phase-modulated multicolor meta-hologram (MCMH) that is polarization-dependent and capable of producing images in three primary colors. The MCMH structure is made of aluminum nanorods that are arranged in a two-dimensional array of pixels with surface plasmon resonances in red, green, and blue. The aluminum nanorod array is patterned on a 30 nm thick SiO_2 spacer layer sputtered on top of a 130 nm thick aluminum mirror. With proper design of the structure, we obtain resonances of narrow bandwidths to allow for implementation of the multicolor scheme. Taking into account of the wavelength dependence of the diffraction angle, we can project images to specific locations with predetermined size and order. With tuning of aluminum nanorod size, we demonstrate that the image color can be continuously varied across the visible spectrum.

Improved air stability of perovskite solar cells via solution-processed metal oxide transport layers

Jingbi You, Lei Meng, Tze-Bin Song, Tzung-Fang Guo (郭宗枋), Yang (Michael) Yang, Wei-Hsuan Chang, Ziruo Hong, Huajun Chen, Huanping Zhou, Qi Chen, Yongsheng Liu, Nicholas De Marco & Yang Yang*, *Nature Nanotechnology* **11**, 75-81 (2016)

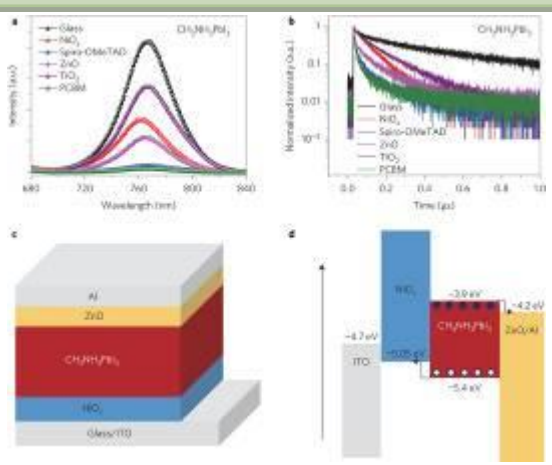


Fig. a, Photoluminescence of $CH_3NH_3PbI_3$ contacted with different interfaces: glass, NiO_x, spiro-OMeTAD, ZnO, TiO_2 and PCBM. **b**, TRPL data for $CH_3NH_3PbI_3$ contacted with different interfaces: glass, NiO_x, spiro-OMeTAD, ZnO, TiO_2 and PCBM. **c**, Overall device structure, consisting of glass/ITO/NiO_x/$CH_3NH_3PbI_3$/ZnO/Al. **d**, Energy band alignment of the metal-oxide-based perovskite solar cell according to UPS measurements from Fig. 2c,f.

Lead halide perovskite solar cells have recently attracted tremendous attention because of their excellent photovoltaic efficiencies. However, the poor stability of both the perovskite material and the charge transport layers has so far prevented the fabrication of devices that can withstand sustained operation under normal conditions. Here, we report a solution-processed lead halide perovskite solar cell that has p-type NiOx and n-type ZnO nanoparticles as hole and electron transport layers, respectively, and shows improved stability against water and oxygen degradation when compared with devices with organic charge transport layers. Our cells have a p–i–n structure (glass/indium tin oxide/NiOx/perovskite/ZnO/Al), in which the ZnO layer isolates the perovskite and Al layers, thus preventing degradation. After 60 days storage in air at room temperature, our all-metal-oxide devices retain about 90% of their original efficiency, unlike control devices made with organic transport layers, which undergo a complete degradation after just 5 days. The initial power conversion efficiency of our devices is 14.6 ± 1.5%, with an uncertified maximum value of 16.1%.

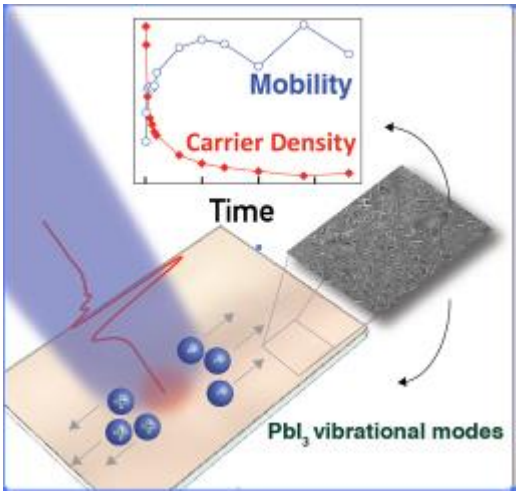
Thailand (Source: King Mongkut's University of Technology Thonburi (KMUTT))

(1) Guided polymer patterns with nanoscale precision by DNA

Though normally known as the genetic material in living organisms, its distinctive physical and chemical properties make DNA a good candidate for self-assembly nanomaterials, such as a programmable nanomaterial for bottom-up manufacturing. Recently, Abhichart Krissana-prasit, a Nano@KMUTT member and postdoc at Aarhus University, has collaboratively with Gothelf lab published two articles in Nature Nanotechnology (2015) and ACS Nano (2016) on this exciting topic of DNA nanotechnology. They demonstrated spatial control and programmed switching of individual polymer conformations on predesigned DNA nanostructures so called DNA origami. The extended single-strand DNA tracks on DNA origami serves as a template for routing an individual conjugated polymer in a controllable fashion including a straight line, 90° curves, U-shapes, circular shapes, and also zig-zag patterns. The demonstration paves a new route for the development of nanophotonic and self-assembled nanoelectronic circuitry in the future.

(2) An Inside View of Perovskite Solar Cells

What make perovskites so good as the next generation solar cells? Their high efficiency and easy fabrication via low-cost solution processes undoubtedly make them a super star of the age. But why are they so efficient? The answer is related to the microscopic behavior of charge carriers generated by sunlight. After photon absorption, just like any semiconductor, electrons are excited across the band gap leaving out positive charges called holes behind. These pairs of positive and negative charge carriers could move around; as long as they travel fast and far enough to reach the electrode before any lost mechanisms occur, the solar cells will generate electricity. The ability to map out the characteristics and behaviors of carriers after photo excitation is indeed a very crucial piece of information for the optimization of perovskites.



A collaboration among KMUTT (Thailand), NTU (Singapore), and Caltech (USA) has led to the investigation of the photo-generated carriers by use of terahertz light. Their findings suggest that three factors play a role in the solar cell efficiency: the film orderliness, crystal phase, and phonon modes. The work is published in Nature Communications, 6, 7903 (2015) and Journal of Physical Chemistry Letters, 7, 1 (2016).

Japan (Source: Japan Science and Technology Agency (JST))

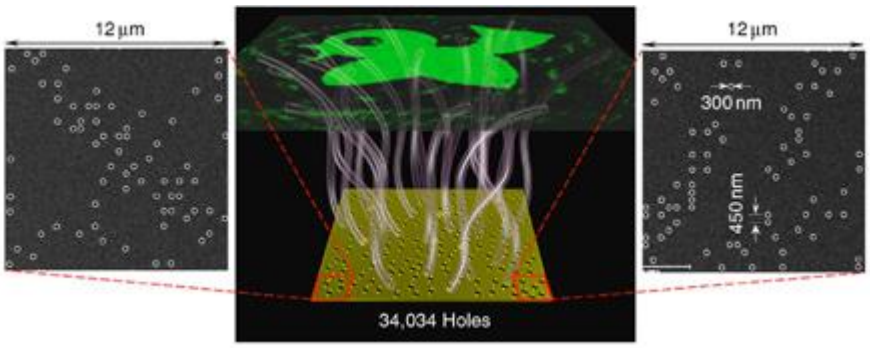
A whole mouse made transparent

In the observation of brain cells, the light is scattered by water, protein, and lipid in the cells, making it unclear to see. Professor Ueda thought that" if it cannot be seen, it should be made see-through." He has removed the lipid which causes the scattering of light and made the refractive index in the tissue uniform, and succeeded in obtaining a highly transparent brain sample. However, an effective method was needed for the removal of endogenous pigments that absorb lights in order to achieve transparency in organs with high content of endogenous pigments such as a heme in red blood cells, for example liver and spleen. Many researchers have attempted to make the organs transparent in the past; however no efficient method was discovered for the removal of pigment in tissues containing endogenous pigments without disruption of proteins. The solution to this problem was the transparency reagent (ScaleCUBIC reagent, hereinafter referred to as CUBIC reagent) used in CUBIC*, which Professor Ueda and his colleagues developed as whole-brain imaging and analyzing technology. This reagent was accidently discovered to efficiently decolorize blood. They have clarified the mechanism where aminoalcohol, a component in CUBIC reagent, efficiently dissolves the red pigment heme in the blood, resulting in decolorization of the blood.

Entire mouse made transparent (the left figure shows the infant mouse, the right figure shows the adult mouse)-Image provided by Riken

Singapore (Source: Institute of Materials Research & Engineering (IMRE) http://www.imre.a-star.edu.sg/)

(1) Light' technology prevents counterfeiting



Sketch of photon sieve hologram with a target plane located 500 µm away from its surface. Insets: scanning electron microscope images of the left and right bottom of the photon sieve.

Holographs typically suffer from twin image and high-order diffraction problems. A team of scientists, including Dr Teng Jinghua and Dr Liu Hong from IMRE, solved this problem through a new ap-proach of using nanoscale holey photon sieves in the visible light spectrum.

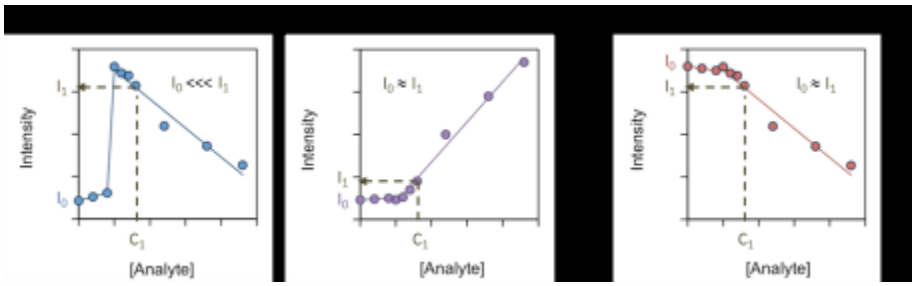
This technique can be used to create distinct super-sharp holograms that are not easily duplicated and thus be applied on bank notes and credit cards to prevent counterfeiting.

This new breakthrough came about from a hybrid approach of designing a random and aperiodic photon sieve that can be used for high-accuracy control of the amplitude, phase and polarisation of visible light. The scientists overcame the chal-lenge of accurately handling numerous unit elements (of light) in a miniaturised device. The random photon sieve forms a uniform, twin-image free and high diffraction-efficiency hologram while a non-periodic photon sieve focuses light into a super-resolution spot.

A randomly distributed photon sieve to realize high-uniformity optical holography is schematically shown in the illustration. The photon sieve was fabricated with 34,034 holes of 150nm radius randomly distributed in a 100-nm-thick chromium film via electron-beam lithog-raphy. Electron microscope images, as depicted in the inset, clearly show random-ness with the minimum centre-to-centre distance of 450nm between two neighbouring holes. This demonstrates an improvement by nearly 200 times in spatial resolution than the similar halftone-based hologram with the smallest pixel pitch of 80 µm.

The team has already applied for a patent on their new method and is currently exploring the practical use of the technology with a mint.

(2) Cancer diagnosis made easier and faster



(A) Inverse sensitivity response and (B & C) traditional proportional responses.

In analytical chemistry, the low reliability for low analyte concentrations near the limit of detection (LOD) is a common problem. Current solutions such as signal amplification involving enzymatic reactions and/or labelling the analyte with large tags increase the complexity of the designs and resource investment as they are very difficult to increase signal-to-noise (S/N) ratio due to the amplified back-ground signal. IMRE scientists have discovered a plasmonic nanosensor for detecting circulating cell-free DNA (cfDNA) with inverse sensitivity (the lower the concentration of the analyte is, the higher the response intensity). This method employs gold nanorods (AuNRs) coated with hexadecyltrimethylammonium bromide (CTAB) and their electrostatic interactions with double stranded DNA (dsDNA). The inverse sensitivity is achieved by the unusual DNA concentration-dependent AuNR aggregation, which can be measured by UV-Vis spectroscopy. This nanosensor has high accuracy for low concentration detection with a tunable dynamic range, making it suitable for monitoring cfDNA levels associated with a wide range of cancer types. Furthermore, results from a patient's therapeutic response and dis-ease progression can be made known much easier and quicker. This analytical method can be easily implemented in most hospital laboratories that are equipped with a simple photospectrometer or a microplate reader.

Japan (Source: National Institute for Materials Science (NIMS))

World's Highest Magnetic Field (1,020MHz) NMR developed : A New Powerful Tool for Nanotechnology Application of High-Temperature Superconductor Was the Key.*

The research team consisting of researchers at NIMS, RIKEN, Kobe Steel and JEOL RESONANCE (a consolidated subsidiary company of JEOL) successfully developed the NMR (nuclear magnetic resonance) system equipped with world's highest magnetic field, 1,020 MHz, during engagement in the JST-SENTAN program "Development of Systems and Technology for Advanced Measurement and Analysis". In addition, taking actual measurements with this new system, the team confirmed its considerably enhanced performance compared to conventional NMR systems in terms of sensitivity and resolution.

NMR systems have been used for various purposes including 3D conformational analysis of biopolymers such as proteins, organic chemistry and materials research. In particular, it is one of the indispensable tools for the development of new drugs. In the development of a new drug, it is vital to understand protein structures in a quick and accurate manner. In this view, improving the performance of NMR systems is of great importance. Magnetic field strength is a key indicator of the performance of NMR systems, and thus there had been fierce competition to develop NMR systems with magnetic fields greater than 1,000 MHz. For a long time, it was broadly expected that the use of high-temperature superconducting technology would enable producing magnetic fields

above 1,000 MHz. However, because high-temperature superconductors had problems such as being fragile and difficult to process, no party had achieved their practical use for a long run.

Through developing several new technologies including the conversion of the high-temperature superconductor developed by NIMS in 1988 into the form of wire material, the research team recently created the NMR system equipped with world's highest magnetic field at 1,020 MHz. Before making this accomplishment, the team spent 20 years of planning, designing and construction, as well as overcoming many hardships such as suspension of the project due to the damage to the nearly completed system caused by the Great East Japan Earthquake, encountering a serious worldwide shortage of helium supply, and the sudden passing of the team leader.

It is expected that the super-high magnetic field NMR will greatly contribute to various fields such as structural biology, analytical chemistry and materials engineering. Furthermore, considering that NMR requires a magnetic field with extraordinary precision, the high-temperature superconducting technology that was cultivated during the development of NMR is applicable to various high-tech systems such as MRI (magnetic resonance imaging), nuclear fusion, linear motor trains and superconducting power cables.

This research result was published in Journal of Magnetic Resonance, 256, 30-33 (2015). (Kenjiro Hashi, Shinobu Ohki, Shinji Matsumoto, Gen Nishijima, Atsushi Goto, Kenzo Deguchi, Kazuhiko Yamada, Takashi Noguchi, Shuji Sakai, Masato Takahashi, Yoshinori Yanagisawa, Seiya Iguchi, Toshio Yamazaki, Hideaki Maeda, Ryoji Tanaka, Takahiro Nemoto, Hiroto Suematsu, Takashi Miki, Kazuyoshi Saito and Tadashi Shimizu, Title:"Achievement of 1,020 MHz NMR", DOI:10.1016/j.jmr.2015.04.009).

*World's Highest Magnetic Field: 1020MHz (24.0T) As of Apr 17, 2015

Photo: A part of the recently developed 1,020 MHz-NMR system equipped with superconducting magnets (about 5 m high and weighing about 15 tons). This part contains coils made of a high-temperature superconductor. Liquid helium is used for cooling.

✧ MAJOR EVENTS 2016

Date	Avenue	Events
27/1/2016 - 29/1/2016	Tokyo, Japan	**Japan nano tech 2016** (www.nanotechexpo.jp)
28/1/2016 - 29/1/2016	Kuala Lumpur, Malaysia	**4th International Congress on Nano Science and Nanotechnology (ICNT 2016)** (http://www.icnt2016.org/)
7/2/2016 - 11/2/2016	Canberra, Australia	**ICONN 2016 - International Conference on Nanoscience and Nanotechnology** (http://www.ausnano.net/iconn2016/index.php)
3/04/2016 - 8/04/2016	Krems, Austria	**Asia Nanotech Camp 2016 (**www.asia-anf.org)
17/5/2016 - 19/5/2016	Tehran, Iran	**International Forum on Nano Olympiad, Certification and Labeling of Nanotechnology Products** (http://news.nano.ir/54356/2)
15/6/2016 - 17/6/2016	Taipei, Taiwan	**Nano Taiwan 2016, the 14th International Nano Exposition** (http://www.nano-taiwan.com/?lang=eng)
27/6/2016 - 29/6/2016	Graz, Austria	**2nd International Conference - Integrated Functional Nano Systems(nanoFIS 2016)** (http://www.nanofis.net)
11/7/2016 - 14/7/2016	Brisbane, Australia	**5th International Symposium on Graphene Devices (ISGD-5)** (http://www.isgd5.com)
13/7/2016 - 15/7/2016	Seoul, South Korea	**Asia Nano Forum Summit 2016 & NANO KOREA 2016** (http://sympo.nanokorea.or.kr/2016/eng/main)
13/7/2016 - 16/7/2016	Brisbane, Australia	**8th International Symposium on Nano and Supramolecular Chemistry (**https://isnsc.event.uq.edu.au)
5/10/2016 - 8/10/2016	Tehran	**Iran Nano 2016** (http://festival.nano.ir/?lang=2)
27/11/2016 - 29/11/2016	Bangkok, Thailand	**NanoThailand 2016** (http://www.nanotec.or.th/en/?p=10079)
28/11/2016 - 29/11/2016	Langkawi Island, Malaysia	**Advanced Materials Conference (AMC 2016)** (http://www.amc2016sirim.com)
12/2/2017- 16/2/2017	Queenstown, New Zealand	**8th International Conference on Advanced Materials and Nanotechnology** (http://confer.co.nz/amn8/)
15/2/2017- 17/2/2017	Tokyo, Japan	**Japan nano tech 2017** (www.nanotechexpo.jp)

✧ Asia Nanotech Camp 2015

Introduction

The Asia Nano Forum (ANF) is a network organization, founded in May 2004, to promote excellence in research, development and the economic uptake of nanotechnology within the Asian region. This collaborative network seeks to benefit its member economies educationally, socially, environmentally and economically by fostering collaboration and acting as a focus for regional and global nanotechnology issues. Asia Nano Forum (ANF) Network is supported by 15+1 economies in the Asia Pacific Region including Australia, Austria, China, Hong Kong, India, Indonesia, Iran, Korea, Japan, Malaysia, New Zealand, Singapore, Taiwan, Thailand, UAE and Vietnam.

The Institute of Materials Research and Engineering (IMRE), is a research institute of Agency for Science, Technology and Research (A*STAR). Established in September 1997, we have built strong capabilities in materials analysis, characterisation, design & growth, patterning & fabrication, synthesis & integration. IMRE is an institute of talented researchers equipped with state-of-the-art facilities such as the SERC Nanofabrication and Characterisation Facility to conduct world-class materials science research.
We develop core competence and interdisciplinary teams in critical technology areas, enabling fundamental new discoveries, the development of advanced materials that lead to new commercial products, and the transformation of various technologies. Our rich pool of research activities are organised under nine thrusts to focus on mission-oriented research that advances scientific discovery and technological innovation.
Partnering international organisations, research institutes and industry in a synergistic, multidisciplinary and collaborative approach to materials research further fulfils IMRE's vision to be the leading research institute for materials science and engineering.

Asia Nanotech Camp (ANC)

ANC is a program initiated by ANF, it serves as a platform for young researchers involved in nanotechnology to learn about the cutting-edge nanotech advancements, conduct site visits, experience collaboration with members from other economies by doing group projects which are evaluated by invited expert panellist. The participants are able to enjoy hospitality and local culture experience provided by the host.

ANC2015

The Asia Nanotech Camp (ANC) 2015 was held during August 2-6, 2015 in Singapore. This event was jointly organized by the Asia Nano Forum and Institute of Materials Research and Engineering (IMRE), A*STAR Singapore, supported by Nanyang technological University (NTU) and National University of Signapore (NUS)This year, the ANC was held in conjunction with the 12th Asia Nano Forum Summit (ANFoS2015) and the 5th Molecular Materials (M3) conference which was happened during August 2–5.

An exciting and enriching program has been prepared, featuring technical lectures by experts in various areas of nanotechnology, industry seminars, visited to universities and research institutes, as well as networking and social and culture activities.

Welcome Address from the Host Organization

It gives me immense pleasure in welcoming you all to the 8th Asia Nano Camp (ANC 2015) organised by the Institute of Materials Research and Engineering (IMRE), along with the kind support of two premier institutions, the National University of Singapore (NUS) and the Nanyang Technological University (NTU). The summit held on Aug 02-07 2015 is organised in conjunction with the 5th Molecular Materials Meeting (M3) conference at the renowned Resorts World Sentosa.

This is a great time to visit Singapore, as the country is celebrating its 50th independence day, marked by high level of vibrance and activity. Living with the spirit of going beyond the physical boundary of being a red dot, it is heartening to see so many overseas experts meeting in Singapore to discuss on a technologically important theme of nanotechnology.

This year, Singapore has the honour of hosting the two key events of ANF, the Asia Nano forum Summit (ANFoS) and the Asia Nanotech Camp (ANC) commemorating with Singapore's 50th birthday. The two events, namely, ANFoS2015 and ANC 2015 are marked with activities, such as, technical sessions on topics related to nanotechnology, viz, Nano Education, Nano Safety, Nano Standardization, Societal implication/influence of nanotechnology, Sustainability, etc. We also have talks by invited experts in Singapore to the early career researchers from the ANF member economies, visits to Institutes of Higher Learning, industry and other social and cultural experiences in Singapore.

Asia Nanotech Camp (ANC) is known to be a platform for young nanotechnology talents from the region to network, deliberate and collaborate. I am delighted to know that 33 of the best and brightest young nanotechnology scientists from 12 economies, (Australia, China, Hong Kong, Iran, Japan, Korea, Malaysia, New Zealand, Singapore, Taiwan, Thailand and Vietnam) are attending this camp.

I am equally delighted to know that the average age for the participants is about 30 years! It is the prime age to be a researcher, brimming with new ideas, vigour and ready to take new challenges.

I wish all the participants a pleasant, memorable and fruitful stay in Singapore with new experiences, friends and collaboration opportunities. I also urge the delegates to take some time out from the formal commitments to experience the rich cultural, tourist and culinary experiences of Singapore.

Dr Ramam AKKIPEDDI
Chair, ANC Organising Committee,
Head of Industry Alliance, Institute of Materials Research and Engineering (IMRE), A*STAR
Vice-President (2014-2015), Asia Nano Forum (ANF)

Welcome Address from the ANF Secretariat

Dear ANC2015 Participants,

Welcome to the Asia Nano Camp (ANC) 2015 and Asia Nano Forum Summit 2015 to be held in Singapore early August of 2015!

The ANC in the past created life changing experiences for our participants, and I hope you will enjoy the same experiences. You are invited to ANC as some of the most promising researchers in the field of nanotechnology, I would like to emphasize to you that it is critical that you develop the sense of responsibility and sustainability in your research and future career in nanotechnology and beyond.

Being aware of social, environmental and economic aspects of sustainability helps you develop the holistic mind set in everything you do including your research career in nanotechnology. I will be one of your mentors during ANC2015 and I look forward to interacting with you and sharing with you my vision and practices in sustainable nanotechnology development.

Meanwhile, enjoy being in Singapore and wonderful program put together with the Singapore organizing committee!

Dr. Lerwen LIU
Managing Director of NanoGlobe
Founding Secretary of Asia Nano Forum

Gallery






Program

August 02, 2015（Sunday）

Arrival of Participants

Venue: *Nanyang Executive Centre (NEC),* 60 Nanyang View, S(639673)

18:30 *Welcome Dinner & Networking (with ANF Summit delegates)*
Fusionspoon, 50 Nanyang View, S(639667)

20:00 *Group Project Discussion*

August 03, 2015（Monday）

Venue: *Nanyang Technological University*, MSE meeting room, N4.1-01-28

08:45 *Opening remarks*

09:00 *Self-Introduction by participants*
Each participant is allowed to prepare 3-5 (3-5 minutes) slides to introduce himself/herself and his/her work.

10:30 *Tea break and Networking*

11:00 *Self-Introduction by participants - continue*

12:00 *Lunch and Networking*

13:30 *Lecture 1: Engineered Semiconductor Nanostructures for Improved Photocatalytic Activity*
Prof Zhong CHEN, School of Materials Science & Engineering, NTU

14:00 *Lecture 2: Nanostructured cathode materials for energy storage*
Assoc Prof Alex YAN Qingyu, School of Materials Science & Engineering, NTU

14:30 *Lecture 3: Landscape of Two-dimensional Materials: Synthesis, Characterization and Applications*
Asst Prof LIU Zheng, School of Materials Science & Engineering, NTU

15:00 *Tea Break and Networking*

15:15 *NTU Lab Tours*
1. Organic Materials Service Lab
2. Facility For Analysis Characterisation Testing Simulation (FACTS) Lab

16:30 *Walk back to NEC*

17:00 *Departure for City Tour*

18:00 *Dinner at lao pa sat and free time in City*

22:20 *Gather in City (venue to be decided)*

22:30 *Depart for Nanyang Executive Centre*

August 04, 2015 (Tuesday)

Venue: Convention Centre, Resort World Sentosa

08:00 *Depart Nanyang Executive Centre for Resorts World Sentosa (M3 Conference)*

08:45 *Registration for M3 Conference*

Venue: Leo 1, Convention centre, Resorts World Sentosa

09:00 *Plenary: Moving Research from the Laboratory to a Start Up: perspectives from a Singapore Professor (Venue: WEST 2)*

Prof. Freddy Boey, Nanyang Technological University

09:45 *Tea Break and Poster Session*

10:00 *"ANF Session on Nanotechnology & Sustainability" under M3 Conference*

Moderator: Dr. Lerwen LIU, ANF Founding Secretary

Strategies to Erase the Nanotechnology Divide

Prof. Seeram RAMAKRISHNA, Director of Centre for Nanofiber & Nanotechnology, Materials Engineering, NUS

Nano Risk Governance: Extending the limits of regulatory approaches through expert dialogues

Mr. Andre GAZAO, President, Austrian Nanotechnology Information Commission of the Austrian Ministry of Health

Toward a World Premier International Research Centre for Nanotechnology

Mr. Takahiro FUJITA, Executive VP, National Institute for Materials Science (NIMS)

Bionanomaterials for diagnostic, imaging and drug delivery : Platform Technology Towards Sustainable Healthcare

Dr. Uracha RUKTANONCHAI, Director of Nanotechnology Research Unit, National Nanotechnology Centre

The education programs for nanoconvergence technology expertise in Korea

Prof. Yoon-Hwae HWANG, Professor, Department of Nanomaterials Engineering , Pusan National University

Nano Education in Taiwan

Prof Yung-Tang NIEN, National Formosa University, Taiwan

Nanotechnology Education in Iran and Future Directions

Prof. Saeed SARKAR, secretary general of Iran Nanotechnology Initiative Council (INIC), Iran

12:15 *Lunch Break*

13:15 *Plenary: The Science and Technology of Quantum Dots: Fundamentals, Biological and Optoelectronic Applications, and into the Market.*

Prof. Moungi Bawendi, MIT

14:00 *Afternoon sessions at M3 and free time at Sentosa (including dinner)*

22:00 *Gather at the gate of Sentosa Express Station at VivoCity (Lobby L, Level 3)*

Harbour Front MRT Station (NE1/CC29) is located at basement of VivoCity

22:15 *Depart for Nanyang Executive Centre*

August 05, 2015 (Wednesday)

Venue: National University of Singapore (NUS)

Department of Physics, NUS & Campus for Research Excellence and Technological Enterprise (CREATE), Utown, NUS

08:30 *Depart Nanyang Executive Centre for NUS Physics Conference Room*

Venue: Physics Conference Room (S13-M01-11)

09:30 *Welcome Speech*

Prof. Chorng Haur SOW, Head, Department of Physics, NUS

09:45 *Lecture 1: Nanofibers and Nanoparticles*

Prof. Seeram RAMAKRISHNA, Director of Centre for Nanofiber & Nanotechnology, Materials Engineering, NUS

10:15 *Lecture 2: Opportunity for Oxides in Electronics, Optics, Magnetics, Memory, Energy and Health*

Prof. T. Venky VENKATESAN, Director, NUS Nanoscience and Nanotechnology Initiative (NUSNNI)

10:45 *Depart for CREATE (Campus for Research Excellence and Technological Enterprise), UTown, NUS*

Venue: SMART Enterprise Level 5, Perseverance Rooms, CREATE

11:10 *Lecture 3: Introduction of CREATE*

Dr. LIM Khiang Wee, Campus for Research Excellence and Technological Enterprise

11:30 *Visit to NEW – NanoMaterias for Energy and Water Management*

12:00 *Visit to SinBeRISE - Singapore-Berkeley Research Initiative for Sustainable Energy*

12:30 *Depart for Physics Department, NUS*

Physics Conference Room (S13-M01-11), NUS

12:45 *Lunch and Networking*

14:00 *Lab Visit to NUS Nanoscience and Nanotechnology Initiative (NUSNNI) or NUS Centre for Advanced 2D Materials and Graphene Research Centre*

15:00 *Lecture 4: Synchrotron radiation: a powerful tool to reveal and engineer fundamental properties of nanomaterials*

Prof. Andrivo RUSYDI, Department of Physics, NUS

15:30 *Tea Break*

15:45 *Lecture 5: Probing Atomics and Molecules*

Prof. Andrew T.S. WEE, Director of the Surface Science Laboratory, Vice President of NUS

16:15 *Lecture 6: The Physicochemical Properties of Colloidal Semiconductor Nanocrystals*

Prof. CHAN Yin Thai, Associate Professor in the Department of Chemistry, NUS

17:00 *Depart for Nanyang Executive Centre*

18:00 *Dinner at Fusionspoon*

50 Nanyang View, S(639667)

19:00 *Group Project Discussion*

August 06, 2015 (Thursday)

Venue: Biopolis & IMRE

IMRE: Conference Room 1, Level 1

08:00 *Depart Nanyang Executive Centre for IMRE*

09:00 *Group competition (15 mins for each group, 5mins Q&A) with Tea Break*

Group 1: Lifestyle technologies

Group 2: Sustainable technologies

Group 3: Medical technologies

Group 4: Environment and water technologies

Group 5: Energy technologies

Group 6: Smart city/nation (internet of things) technologies

11:30 *Lecture 1: Atom-level Control : From 3-D to 0-D*

Dr. Kuan Eng Johnson GOH, Head of SERC Semiconductor Nanofabrication, Processing & Characterization Group, IMRE

12:00 *Lecture 2: Redefining Colour Printing with Plasmonic Nanostructures*

Dr. Shawn TAN, Assistant Head, Technology Development Office, IMRE

12:30 *Lunch at IMRE, meet IMRE's Talent Development Committee*

13:30 *Lecture 3: Nanostructured Functional Surfaces*

Dr. TAN Wui Siew, Head of Soft Surface and Interfaces Laboratory, IMRE

14:00 *Lecture 4: Advanced Polymeric Design in Nanomedical and Consumer Care Applications*

Dr. Jatin Kumar, Scientist, IMRE

14:30 *Awards and Closing Ceremony*

15:00 *Depart for A*STAR Fusionworld*

15:30 *Visit A*STAR Fusionworld*

17:30 *Leave for City*

18:00 *Dinner & Free time at City*

22:30 *Gather at Esplanade / Suntec city Convention center , Depart for Nanyang Executive Centre*

August 07, 2015 (Friday)

Departure of Participants

Invited Speakers

 **Prof. CHEN Zhong,** *Prof., School of Materials Engineering, Nanyang Technological University Singapore*	 **Prof. Alex YAN Qingyu** *Assoc. Prof., School of Materials Engineering, Nanyang Technological University, Singapore*	 **Prof. LIU Zhang** *Assis. Prof., School of Materials Engineering, Nanyang Technological University, Singapore*
 **Prof. Seeram RAMAKRISHNA,** *Director of Center for Nanofiber & Nanotechnology, Materials Engineering, NUS, Singapore*	 **Prof. T. Venky VENKATESAN,** *Director, NUS Nanoscience and Nanotechnology Initiative (NUSNNI), Singapore*	 **Dr. LIM Khiang Wee** *Executive Director of CREATE*, Singapore
 **Prof. Andrivo RUSYDI,** *Department of Chemistry, NUS,Singapore*	 **Prof. Andrew T.S. WEE,** *Director of the Surface Science Laboratory, Vice President of NUS, Singapore*	 **Prof. CHAN Yin Thai,** *Associate Professor, Department of Chemistry, NUS, Singapore*
 **Dr. Kuan Eng Johnson GOH** *Head of SERC nano Fabrication, Processing and Characterisation, IMRE, Singapore*	 **Dr. Shawn TAN,** *Assistant Head, Technology Development Office; Scientist, Patterning & Fabrication, IMRE, Singapore*	 **Dr. TAN Wui Siew,** *Head of Soft Surface and Interfaces Laboratory, IMRE, Singapore*
 **Dr Dr Jatin KUMAR,** *Scientist, IMRE Singapore*		

ANC Group Competition

Topics

Each group is assigned one of the below topics for presentation. The teams must present on their assigned topic and focus their founding to the field of nanotechnologies.

- Lifestyle technologies – Technologies that support and shape our day to day routine and comfort/quality of life.
- Sustainable technologies – Technologies allowing recycling and biodegradable materials.
- Medical technologies – Technologies applied to medical science intended to diagnose, treat and/or improve the quality of healthcare.
- Environment and water technologies – Technologies that tackle environmental issues (air pollution, water supply and quality and to the relation to population growth and economic development including manufacturing and agriculture).
- Energy technologies – Technologies addressing the production and usage of energy and minimizing carbon footprint and environmental impact.
- Smart city/nation (internet of things) technologies – how nanotechnology may influence the sensors, connectivity and other aspects in a smart system.

Award Criteria and Evaluation Panel

Presentations are evaluated by a panel of experts for the ANC 2013 reward. The First, Second, and Third Prize is 80USD, 60USD and 40USD per member respectively.

Award Criteria

Groups are expected to present their findings. Each group presentation is limited to 15 minutes. At the end of the oral presentations, there will be a 5-minutes Q&A session.

Judges will evaluate the presentation based on the following criteria:

- Scientific thought: team's ability to choose a significant scientific topic that could attract broad audience and identify a creative scientific idea.
- Engineering innovation: team's ability to adopt a novel scientific principle and integrate into a system solution through design/engineering processes.
- Teamwork: team's ability to cooperate, delegate, motivate each other. All team members should contribute to the work and presentation as much as possible.
- Presentation skills: team's ability to present coherently with clarity.
- Clarity: the team's ability to discuss the scientific topic concisely and logically, present the data and conclusion clearly.

Evaluation Panel:

Dr. Lerwen LIU, Managing Director of NanoGlobe and Secretary of Asia Nano Forum.

Dr. David PARAMELLE, Scientist of IMRE

Dr. WONG ZhengZheng, Scientist of IMRE

Dr. Evan WILLIAMS, Scientist of IMRE

Dr. Hong Ye YE, Scientist of IMRE

Dr. Jatin KUMAR, Scientist of IMRE

Projects Executive Summary

First Prize – Group E: Energy Efficiency and Renewable Energy through Nanotechnology

Team: Kang LIANG (Australia), DENG Ran (Hong Kong), Dong-Myeong (Korea), Ong Poh Shing (Malaysia), Christina EFTHYMIOU (New Zealand), Teguh Citra ASMARA (Singapore)

Introduction

Energy is one of the biggest determinants of political, economic, and technological growth in a country. Thus, the development of energy technologies in a country should be connected with the environmental, economic, and social sustainability. The aim of the project is to present some significant contributions from many research groups who are mainly unconnected and are working from different viewpoints, to find solutions to one of the great challenges of our time, i.e., the production and use of energy, without compromising our environment, from one of the most exciting and multidisciplinary fields, nanotechnology.

Then project covers in detail all the specific contributions from nanotechnology to the various sustainable energies, but in a broader way, it collects the most recent advances of nanotechnology to sustainable energy production, storage and use. For the benefit of the understanding the overview of the topic, we presented energy sources from the likes of solar, hydrogen and new generation batteries and supercapacitors are described as the most significant examples of the contributions of nanotechnology in the energy sector.

Innovation - Impact of nanotechnology in our life and industry

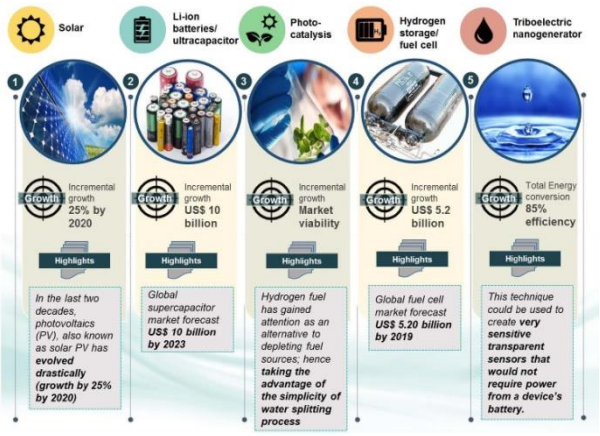


Figure1: Current advancement in energy sector and its market overview

Nanotechnology is in all the energy-related processes that involve the use of solar radiation as an energy source. Solar energy is free and rather available in many parts around the word. This energy source can be used in different ways: photovoltaic (PV) technology – which directly converts light into electrical current, solar–thermal systems – used in solar collectors, artificial photosynthesis – which produces either carbohydrates or hydrogen via water splitting, the so-called 'passive solar' technologies, where building design maximises solar lighting and heating, and even biomass technology – where plants use the solar radiation to drive chemical transformations and create complex carbohydrates, which are used to produce electricity, steam or biofuels. All these energy-related processes and their applications are enclosed in the so-called solar economy

Here, we highlight problems in connection with solar cells that still exist in market. Although the cost of electricity derived from solar cells is quite low, the cost for the construction of photovoltaic parks is quite high. Thus, the fabrication of solar cells from other materials except silicon could be an innovative field in the industry of photovoltaics. Moving one step further, the reduction of the cost of solar cells could increase their use in non-advanced countries by improving the quality of lives, i.e by providing free power.

PV energy can be used to break water molecules into hydrogen and oxygen via the so-called photocatalytic water electrolysis. It means that solar energy can be directly stored in the form of hydrogen. Consequently, although the next section deals with the hydrogen economy, we decided to include artificial photosynthesis in this section (solar economy) because of the use of solar radiation as source of energy for hydrogen production. Water splitting is a broad term used to refer any chemical process in which water is converted into oxygen and hydrogen. Active research in this field includes high temperature electrolysis and water splitting by photocatalysis (artificial photosynthesis). The latter also produces electrons to power the electron transport chain in the photophosphorylation step of the photosynthesis (Figure 2) The research proved that on concentrating sunlight, high temperature and solar flux are achieved, thus, obtaining hydrogen in a cheap and environmentally friendly way, i.e., to split methane into hydrogen and carbon.

Hydrogen itself is a way of transporting and storing energy from the source to the end user. The main renewable sources of energy available in nature, such as solar, wind, geothermal or tidal, need to be transformed, mainly as electricity, to be efficiently transported; unlike hydrogen that needs to be produced. As aforementioned, hydrogen can be produced from renewable energies and conveniently converted into electricity mainly using fuel cell technology. For these reasons, hydrogen, like biofuel, can be considered as an energetic vector, and therefore the core of an energy economy on its own. One of the most attractive features of hydrogen is that the only product of its combustion is water. Consequently, by combining both the production of hydrogen from renewable energies with its use in fuel cells, a new pathway emerges leading to a fully environment friendly energy system, with the subsequent reduction in carbon emissions and the dependency on fossil fuels.

Many of the sustainable energy alternatives herein described produce (e.g. PV solar cells) or require (e.g. water splitting)

electricity. Therefore novel more efficient ways to store electricity are very much needed in the way to a more sustainable production, transformation and use of energy. Some

of the most important energy storage systems are batteries and ultracapacitors.

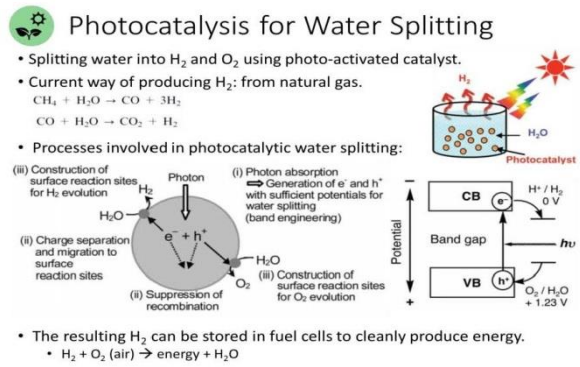


Figure2: Solar energy for hydrogen production: artificial photosynthesis

Supercapacitors or ultracapacitors store electrical energy, like batteries, but using a different mechanism. While batteries do it chemically, ultracapacitors store electricity physically, by separating the positive and negative charges. Since the discovery of ECs these devices have attracted considerably less attention than batteries as energy storage devices. Contribution of nanotechnology and the better understanding of charge storage mechanisms (ion behaviour in small pores) the interest on ECs has noticeably increased recently.(Figure 3)

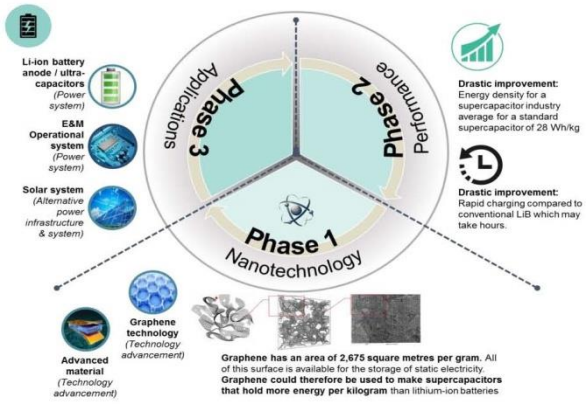


Figure 3: Current advancements in energy storage and its impacts to the industries

Figure 4: Schematic diagram showcasing the operational mechanism of triboelectric nanogenerator

New technologies that can harvest energy from the environment as sustainable self-sufficient micro/nano-power sources are the newly emerging field of nanoenergy, which is concerned with the application of nanomaterials and nanotechnology for harvesting energy to power micro/nano-systems. The discovery of the triboelectric nanogenerator (TENG) is a major milestone in the field of converting mechanical energy into electricity for building self-powered systems. It offers a completely new paradigm for harvesting mechanical energy effectively using organic and inorganic materials (Figure 4). High total energy conversion efficiency (approximately 85%) has been demonstrated, efficiency, a so called organic nanogenerator, which is a disruptive technology for energy. We anticipate that much more enhancement of the output power density will be demonstrated in the next few years.

Conclusion

Sustainable energy production, transformation and use are very much needed to maintain the readily and cheap access to energy to the growing and increasingly demanding world population while minimizing the impact on the environment. The novel multifunctional materials produced from the broad and multidisciplinary field that is nowadays called nanotechnology are critical to overcome some of the technological limitations of the various alternatives to the non-renewable energies. Through nanotechnology PV solar cells are increasing their efficiency while reducing their manufacturing and electricity production costs at an unprecedented rate. Hydrogen production, storage and transformation into electricity in fuel cells are being benefited from more efficient catalysts for water splitting, better nanostructured materials for higher hydrogen adsorption capacity and cheaper simpler fuel cells. Advancement creates novel materials with unique properties whcih are already contributing to overcome some of these challenges. This is an excellent example of how better material science can contribute to the well-being of present and future generations.

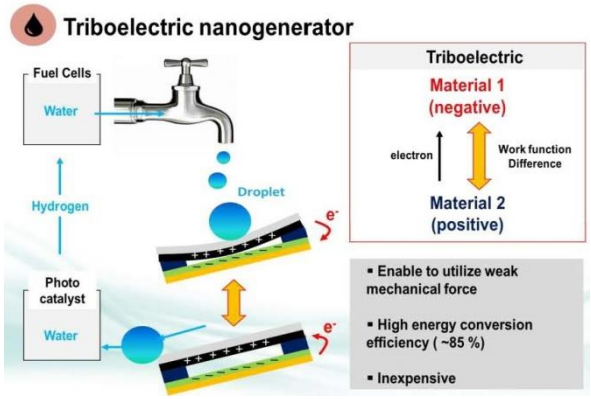
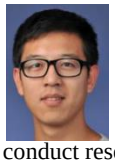


Figure 5: Schematic diagram showcasing the operational mechanism of circular water energy system

Biography

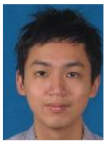


Kang LIANG is Post-Doctoral Fellow of CSIRO Manufacturing Flagship. His research interest includes self-assembly techniques such as coordination chemistry and layer-by-layer assembly, drug delivery, and biotechnology. He conduct research into and develop next-generation particle systems with engineered properties, combining nanotechnology and biochemistry to solve questions in medicine and biology. An important aspect of this is the use of bio-inspired metal-organic frameworks.

Ran DENG is PhD candidate of The Hong Kong University of Science and Technology. Her research interests are primarily in proton exchange membrane fuel cell (PEMFC), especially in confined zeolite-PFSA composite membrane. Combining the confinement and water adsorption capacity of zeolite, PEMFC with zeolite-PFSA composite membrane exhibited excellent performance at high

temperatures and dry conditions. Her research focuses on water transport process within the composite..

Dong-Myeong SHIN is PhD Candidate of *Pusan National University*. His current research backgrounds are related in energy harvesting, biosensor and glass dynamics. Seeking to build a successful career as an experimental researcher in the field of nanotechnology. Broad range of interest in experimental physics, chemistry and material engineering (Piezoelectric nanomaterials, Triboelectric nanomaterials, Energy harvesting devices, Mountable smart device and Biosensors et al.)



Ong Poh SHING is associate of NanoMalaysia Berhad. His research interests are: primarily in solid oxide fuel cell (SOFC); mainly on the doped and/or co-doped cerium oxide electrolytes with divalent and trivalent dopant. He focus on several synthesis approach in preparing the ceramics and also investigation of the oxide ion conductivity and other physiochemical properties of pure single phase material synthesized. He managed to achieve optimized parameters in both solid-state and wet chemical synthesis approaches.

Christina EFTHYMIOU is PhD candidate of Victoria University of Wellington. Her research interests are self-assembly, hydrogels, SAXS, cryo-SEM, bulk rheology.

Teguh Citra ASMARA is research fellow of National University of Singapore. His research interests are condensed matter physics, especially strongly-correlated electron systems, Study of electronic structures and magnetic properties of materials using optics, spectroscopic ellipsometry, and synchrotron-based techniques, Novel quantum phenomena in oxides and oxides interfaces, exotic plasmonic materials, graphene and other two-dimensional materials.

Second Prize – Group F: Smart City/Nation (Internet of Things) Technologies

Team: Stuart EARL(Australia), Shutaro ASANUMA (Japan), YIN Xinmao(Singapore), Fan-Yun CHIU(Taiwan)

Introduction

One-quarter of the world's population is living without electricity and one-ninth is starving. We hope more people enjoy from the benefit of science and technology. However, as matters now stand, it would be difficult that all the world population enjoy the benefit of them, since amount of resources is limited. To resolve this problem, we have to build more high-efficient society, so called "Smart City/Nation".

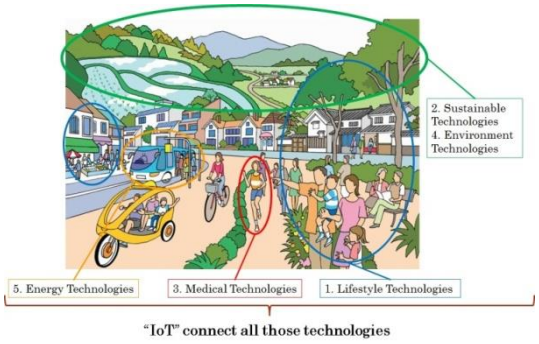
Innovation – Internet of Things (IoT)

To build Smart City/Nation, Internet of Things (IoT) plays a crucial role.

As other groups presented, nanotechnologies can improve following technologies.

1. Lifestyle technologies
2. Sustainable technologies
3. Medical Technologies
4. Environment technologies
5. Energy technologies

Improvement in these technologies can make the society more efficient. However, when these technologies are not connected, the abilities of these technologies are not being drawn out. IoT connect all those technologies and draw out latent abilities of these technologies.(Figure 1)



It is predicted that IoT devices will consist of around 50 billion objects by 2020 and expected that IoT could lead to innovation in technologies such as followings.

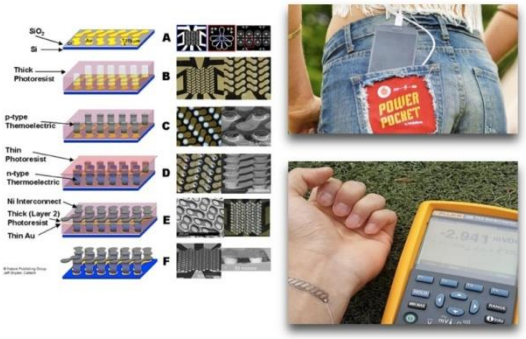
- Interconnected network of physical objects embedded with sensors, electronics, software and connectivity.
- Enables exchange of data
- Currently contains diverse "things", such as:
- Heart monitoring implants
- Biochip implants on farm animals
- Automobile sensors
- Smart thermostats
- Mobile phones

The effect of IoT is most developed in the case of data collection and distribution such as followings.

- Free, in situ, real-time, location-tagged data collection
- Mobile sensors for pollution
- Traffic data for improved management algorithms
- Instant communication
- Via existing internet links
- Unbiased perspective

- Machine collecting data autonomously, no observer bias
- Existing, well-developed technological platforms available
- Mobile phones, computers, traffic cameras

Some examples are thermoelectric applications for Smart Phone and mobile medical sensors. Thermoelectric applications make electricity from body heat and actuate Smart Phone and mobile sensors collect the data of the body condition. Then Smart Phone gathers the data from sensors and sends the data of the body to data center in hospital. At the hospital, doctors check the condition of the body. Like this, IoT can optimize the medical care of the societies.(Figure 2)[1), 2), 3)]



Other examples are organic−inorganic hybrid nanocomposite-based gas sensors for environmental monitoring. Gas sensors have become one of the key technologies for rapid, selective, sensitive, and efficient detection of gases, chemical vapors, and explosives.[4), 5), 6)]

Nanotechnologies play a crucial role not only in connecting the technologies which we mentioned previously but also in fabricating the huge data storage and Beyond CMOS devices such as followings.

- 5 dimensional data storage[7), 8)]
- Spin MOSFET
- NEMS
- Atomic Switch
- Mott FET
- Etc.

Conclusion

We are in the beginning of the IoT and Smart City/Nation age. In the near future, many things in the society are measured by sensors and the data of them are used to optimize the efficient of the society. We hope efficient use of energy lead us to world which more people enjoy from the benefit of science and technology.

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Biography

Stuart Kennett EARL is PhD candidate of The University of Melbourne. His research addresses the interaction between semiconductors and plasmonic structures, nanoscale noble metal structures that behave like antennas for light. Primarily I have been working on the creation of tunable plasmonic devices to enable one to manipulate the peak plasmon resonance wavelength to increase the range of application of this technology. He is also interested in the creation of nanoscale light sources, especially those emitting single photons. By coupling aggregates of semiconducting nanocrystals to optical antennas we are attempting to increase the brightness of quantum emitters.

Shutaro ASANUMA, is researcher of Japan National Institute of Advanced Industrial Science and Technology (AIST). His research interests are mott transistor, electric double layer transistor, correlated electron material, Mott insulatot and thin film.

YIN Xinmao is PhD candidate of National University of Singapore. He xxpertises in the field of condensed matter physics and nanoscale science, with primary strength in studying the electronic and magnetic structures of metal oxide. Sophisticated in synchrotron-based spectroscopy (NEXAFS, ARPES, XMCD, XRD etc.) and other optical analysis techniques (ellipsometry, reflectivity, etc.).

Fan Yun CHIU is PhD candidate of National Taiwan University. She is interesting in research about the materials specific heat. Now I am making the nano calorimeter to measure the thickness dependent sample. She is also working in the thermoelectric material group, for the properties of thermoelectric material, She makes some homemade machine to measure the figure of merit by Harman method and Seebeck coefficient.

Third Prize – Group A: Nanotechnology in Our Life

Team: Zengshuai MA(China), Satofumi MARUYAMA(Japan), Ismayadi ISMAIL(Malaysia), Mark Allen MOXEY(Singapore), Pornthida RIANGJANAPATEE(Thailand)

Introduction

Does nanotechnology affect your lifestyle? This is a question that makes you wonder the exciting and importance of nanotechnology towards human being. From the shoes, clothes, sunglasses and hat you wear to sporting goods and even cleaning products, nanotechnology which often inspired by the natural world plays a big part in the manufacture of many familiar products. Let us look at this scenario, you decided to go on vacation and off the plane and checked into your hotel, you don the wrinkle-free shirt you packed so you wouldn't have to do any ironing. It was a bright and sunny day then you grabbed your scratch-resistant sunglasses and your sunscreen you dash to the hotel pool. At the pool side, a popular pop song was played on your MP3 player, before taking a plunge into the cook refreshing water. Yet throughout your every step of your trip, nanotechnology probably is the furthest from your mind.

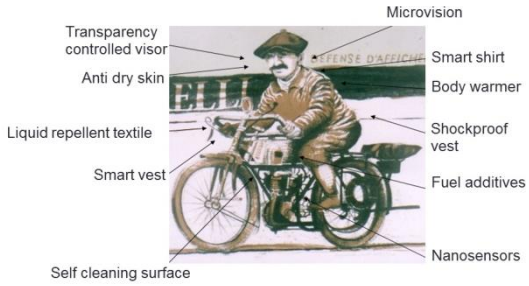


Figure 1: Nanotechnologies in our life

Let us dwell into some interesting nanotechnologies that already impacted our life without realizing its importance function in everyday activities. Nanotechnologies in cosmetic, smart-textiles and self-cleaning products are now widely available on the market. At the forefront of nanotechnology in cosmetics we see companies like l'Oreal, producing anti-wrinkle cream containing nanocapsules, which help active ingredients get to the skin's deeper layers. By reducing the active ingredients to a very small size and coating them with a biodegradable polymer, the company found the nanocapsules were small enough to pierce through the first layers of the skin and release the active ingredients below, in the lower layers of the skin. Anti-dry skin crèmes use oxide powder with nanosized silica powder. Zinc oxide nanoparticles scatter the light, thereby protecting the skin. Besides that, ultra-fine titanium dioxide with the inclusion of a small amount (<1%) of manganese can catalyse free radicals that have been generated by other sunscreen components into harmless chemical species.

Smart-textiles also show significant revolution not only to the human but also the manufacturing processes. Textile manufacturers have begun to use nanomaterials in their products. The unique properties of nanoparticles and nanofibres mean that they can be used to design fabrics with excellent mechanical strength, chemical resistance, water repellence, antibacterial properties, and a wealth of other properties which are unattainable by any other means. Smart textiles are materials that can react or adapt to external stimuli or changing environmental conditions. The stimuli can include changes in temperature, pH, chemical sources, electric or magnetic field or stress. Advanced smart textiles can have embedded computing, digital components, electronics, energy supply and sensors. Two examples of smart-textiles are wearable microstrip patch antenna and bodywarmers. An antenna for wearable health monitors that can be stretched, rolled, or twisted and can return to its original shape is desirable. In order to make this material for wearable antenna, silver nanowires were applied in a certain pattern and a liquid polymer was poured over the nanowires. As the polymer sets, it forms an elastic composite with the nanowires embedded in the desired pattern. The resulting patterned material forms the radiating element of the microstrip patch antenna. The radiating layer is bonded to a ground layer composed of the same composite but with continuous layer of embedded silver nanowires. By manipulating the form and size of the radiating element, the antenna's signal transmission and reception frequency can be controlled. The antenna is able to communicate effectively with remote equipment while being stretch. Bodywarmers consist of phase change materials (PCM) for example a composite of polyethylene gycol and graphene oxide. PCM could respond to your changing body temperature and its property was used as the fabric coating which consist of the PCM encapsulated into microscopic spheres. As your body warms up, the PCM melts, drawing the heat away from you. Once you cool off, the PCM freezes again, in turn releasing its stored heat to keep you cozy.

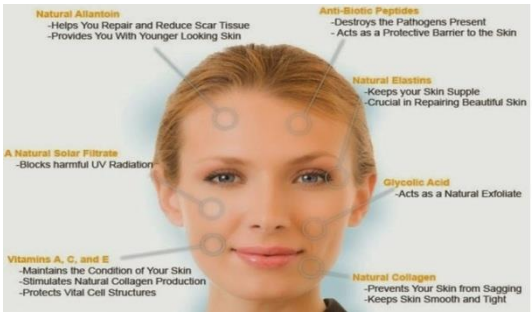


Figure 2: Nanotechnologies in cosmetics

Self-cleaning properties describe materials that repel or degrade dirt or are anti-bacterial. Nano-coatings, nano-structures and nano-particles can be applied to various materials to give self-cleaning properties. Hydrophobic chemicals, most commonly fluorocarbons, can be applied to different materials to produce an "anti-stick" property that can repel most wet foods and dyes. These hydrophobic coatings can be applied to hard and soft materials, including textiles. Certain oxides such as TiO2 can be applied to a materials surface to produce a self-cleaning effect by degrading organic material by a process of photocatalytic oxidation initiated by UV exposure. Self cleaning windows exhibit a thin TiO2 coating, that oxidizes organic contaminants (bird poo!), breaking them down into small water soluble molecules that can be washes away by rain

water. Nano structures can be applied to a surface of a material to produce hydrophobicity without chemical additives. Antimicrobial properties of materials such as silver can be incorporated into another material by adding silver nanoparticles. Silver ions are toxic to bacteria, and can readily kill bacteria and stop it from spreading. Silver nanoparticles can be woven into textiles to help remove or limit odour producing bacteria.

As a conclusion, we use several kinds of nanotechnologies, e.g. cosmetics, self-cleaning etc. These markets are expanding as these technologies make our lives easier and more comfortable. Now there are lots of nanotechnology in the laboratories and they are progressing, nanotechnology, not only cosmetics, self-cleaning, but smart textiles, sensors, will support our lives.

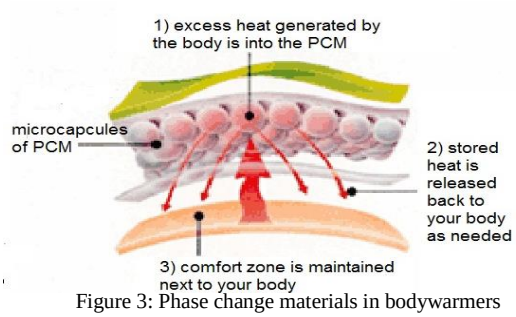
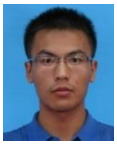


Figure 3: Phase change materials in bodywarmers

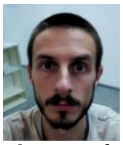
Biography



Zengshuai MA is PhD candidate of Tsinghua University. His research interests include microfludic technology and immuno-agglutination assay. He has finished the design and development of an portable bioaerosol sampler with an integrated micropump which enabled automatic liquid sample delivery. The work that now he is focusing on is the design of immunoassay method and the development of portable detecting instrument.

Satofumi MARUYAMA is postdoc researcher of Japan National Institute for Materials Science (NIMS). His research interests include Boride, Thermoelectric, Thermal conductivity, Spark Plasma Sintering (SPS), Composite material

Ismayadi ISMAIL is research officer of Universiti Putra Malaysia. His research interest is on microstructure-property relationships evolution involving nanometer-size polycrystalline-grain microstructures. He is also working on synthesis of carbon nanotubes (CNT) using floating catalyst CVD and successfully discovered the ways to synthesis CNT sheet and yarn with waste cooking palm oil as the carbon precursor.



Mark MOXEY is scientist of Institute of Materials Research and Engineering, A*STAR, Singapore. His background is in chemistry and his PhD thesis revolved around fabricating nano-patterned surfaces for protein absorption. The main focus of the fabrication methods was to integrate top-down techniques, such as photolithography and nanoimprint lithography, with bottom-up techniques, including self-assembled monolayers and chemical synthesis. He has carried on the basic theme of nanofabrication and I'm now working on developing anti-reflective coatings using a nano-structured resist, imprinted onto glass surfaces, for commercial production.

Pornthida RIANGJANAPATEE is researcher of National Nanotechnology Center (NANOTEC), NSTDA. Her research interests include enhanced stabilities of (cosmetic) actives, formulations of poorly soluble drugs/actives using lipid nanoparticles (SLN, NLC), drug nanocrystals, micelle, liposomes, and nanoemulsions. Profession on topical (cosmetic) actives targeting, pharmaceutical and cosmeceutical nanotechnology, topical dosage forms, antiwrinkle & antiaging cosmetics, cosmeceuticals, pharmaceuticals, natural products, skin irritating test, and skin efficacy test.

Group B : Sustainable Nanotechnology Technology

Team: LIU Zhang(Hong Kong), Najmeh NAJMODDIN (Iran), Naoya OKADA(Japan), OW Sian Yang(Singapore), Kiatnida TREERATTRAKOON(Thailand)

Sustainable nanotechnology involves development that meets the needs of the present without compromising on the ability of future generations to meet their own needs. These technologies are often inspired by nature, such as nature-derived biomaterials or technologies that mimic characteristics and nano-scale structures of many living organisms (e.g. self-healing ability, tolerance and resistance for environmental exposure, self-

assembly, and hydrophobicity). One of the great challenges for sustainable nanotechnology is that is has to be economically viable in the long term, with minimal negative effects to our health and the environment

Reduce: Firstly, it is important to reduce the use of nanomaterials that are resistant to biodegradation or degrade into toxic products. Examples of these are gold nanoparticles that accumulate in the spleen and liver and cadmium based quantum dots that can biodegrade into toxic cadmium ions. Instead, more biodegradable nanomaterials, such as some carbon-based nanomaterials, zinc oxide and magnetic iron oxide particles, should be used preferentially instead. Other possibilities include the use of nano-cellulose instead of silicon for creating biodegradable computer chips.

Reuse: Secondly, nanomaterials that cannot be easily degraded can be designed to be easily reusable by various means. Spent nanoparticles can be recovered for re-use from solutions by nanofiltration, centrifugation or even magnetic fields in the case of magnetic nanoparticles. This enables the nanoparticles to be recovered for reuse for their intended roles, such as being a catalyst. Reusability can also be engineered into the nanoparticle's structure by immobilizing the nanoparticle on supports such as clay, zeolite or carbon, or even creating nanoparticle emulsions that can phase-separate from solutions when needed.

Recycle: Lastly, nanotechnology can use used to promote sustainability by either enabling better recycling or by being able to be produced from waste products. Nanotechnology can be used to create nanotags on plastics to enable easier sorting of plastics for recycling, or be used to create nanomaterials that are more easily recyclable than current materials, such as using carbon fibre for cars as opposed to steel. Existing waste products can also be used to generate useful nanomaterials, for instance, zinc oxide nanoparticles can be produced from old alkali batteries.

By using these three principles, sustainable nanotechnology can be developed. Several companies, such as Goodyear, Sustainpack and Tencel have been developing and using a variety of sustainable nanotechnologies in various commercial and industrial applications. While nanotechnology provides us with great benefits, development of sustainable nanotechnology is essential to ensure that the developments of today do not adversely affect our future.

Biography

LIU Zhang is currently a PhD candidate studying in Division of Environment, the Hong Kong University of Science and Technology. His research interests are in the area of material chemistry and engineering. A central scheme is to develop strategies to prepare different metal-based metal-organic-framework (MOF) aerogels for the utilization of efficient CO2 capture and harmful gas removal. So he works mostly on the design of experiments in the situation where CO2 could be trapped in the MOF aerogel at relatively low temperature & ambient pressure and desorbed in the conditions that do not consume too much energy. Before his PhD study, he also worked on the design of composite photocatalysts for water treatment and received master degree at South China Normal University, Guangzhou, China.

Najmeh NAJMODDIN received her PhD in Material Science and engineering from Iran University of Science and Technology (IUST), as honor student. In 2011, she joined KTH-Royal Institute of Technology as a guest researcher in Sweden. During her stay there, she worked on magnetic mesoporous materials and the effect of nanoconfinement on their properties. She presented her results in 37th International Conference and Expo on Advanced Ceramics and Composites that was held in U.S.A in 2013. Currently she is an assistant Professor at Department of Biomedical Engineering, Science and Research Branch, Islamic Azad University (IAU). Moreover she is with the Iran Nanotechnology Standardization Committee in Iran Nano Initiative Council. Her current research Interests are in synthesis of mesoporous materials, magnetic nanoparticles, targeted Drug Delivery Systems and the effect of nanoconfinement on the properties of materials.

Naoya OKADA is a researcher in Nanoelectronics Research Institute, National Institute of Advanced Industrial Science and Technology (AIST) in Japan. He is working on the synthesis of the transition-metal-atom encapsulated Si clusters and the application to the electrical devices, such as transistor and memory devices using the clusters. He received his doctoral degree in engineering from University of Tsukuba in Japan in 2014, and master degree in engineering from University of Tsukuba in 2007..

OW Sian Yang is a scientist working in the Institute of Materials Research and Engineering (IMRE) of the Agency for Science, Technology and Research (A*STAR) in Singapore. He works on the synthesis and application of nanoparticles, such as gold nanoparticles and carbon dots, in biosensors. The biosensors he works on include rapid detection tests for bacteria and detection of serum biomarkers in patient point-of-care systems. He received his doctorate from the University of Melbourne in 2014 studying the formation and inhibition of amyloid fibrils with various polymers to gain insight into the design of drugs to treat amyloid diseases such as Alzheimer's disease.

Kiatnida TREERATTRAKOON is a research assistant at National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA) in Thailand. Her research interests are in using nanotechnology to improve medical diagnostics. Currently she is working on in vitro and in vivo analysis of functionalized nanoparticles for targeted cancer imaging in a xenograft cancer model in mouse. Additionally, she works on developing a molecular diagnostic platform for detection of nucleic acid biomarkers. She received her bachelor degree in Engineering from Chulalongkorn University, Thailand, in 2009, and master degree in Molecular Biotechnology from Uppsala University, Sweden in 2013.

Group C: Nanotechnology Serves for Medical Technology

Team: Haotian CHEN(China), Kosuke MINAMI(Japan), Nur Aainaa Syafini Binti Mohd RADZI(Malaysia), TAN Wei Ming Alvin(Singapore), Chirawat CHITPAKDEE(Thailand), CAO Thi Thanh(Vietnam)

Introduction

In our daily life, we have a large variety of medical technology in hospitals and/or in our houses. However, most of them are for medical treatments, such as surgery, pacemakers for heart diseases and haemodialysis for kidney dysfunction. In our group project, we discussed how the nanotechnology improves our quality of life as well as makes these medical technologies sustainable, and also proposed the requirement of the continuous diagnosis/monitoring system to find diseases before they become severe.

Problem

Severe diseases make our quality of life lower, such as surgery, heavy consumption of drugs and long hospital stay. In addition, longer medical treatment for the severe diseases makes lower sustainability for our daily life, such as substantial financial burden, chemicals and wastes. It is crucial to detect our diseases early. However, we have to go to the hospital frequently for the diagnosis in early stages. To overcome these issues, we proposed the continuous diagnosis/monitoring system in our daily life without taking clinical diagnosis, "Implantable Diagnosis Devices" (**Figure1**).

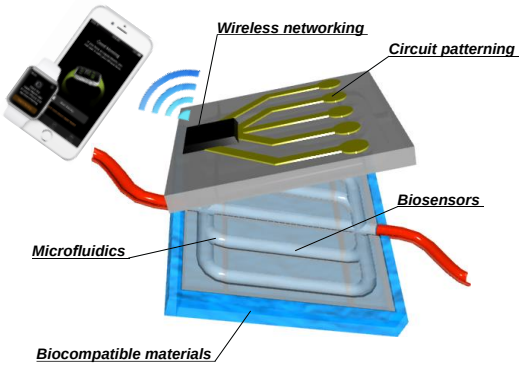


Figure1. Schematic illustration of "Implantable Diagnosis Device"

Innovation

- Making the surface of the devices biocompatible
- Creating biosensor arrays and sensitivity for a large variety of diseases
- Creating and connecting vascular system with the devices
- Connecting the sensors on the networking system/medical doctors
- Making the devices flexible/stretchable for implantation

Proposal

The need for early detection of disease are both beneficial for the planet's sustainability and human lifespan. We propose the establishment of implanted biosensor for multiple diseases that offers real time monitoring of human body. The practicality of such biosensors had been challenged by many constraints due to the harsh requirement in-vivo. This include tissue engineering challenges, material aspect challenges, simulations and commercialization.

Tissue engineering for integration of chip into vascular systems requires knowledge of bioengineering and biomaterials that encompasses biofluidic and biocompatibility of materials. While the few physical constraints for such sensors are the need for stretchability and it had to be small and yet compacted with different sensors for different diseases that rely on nanotechnology to realize. Simulation serves as a vital validation for the incorporation of input from various specialization follow by commercialization of a futuristic lifestyle that smoothens mental and financial transition.

Conclusion

The global efforts on establishing sustainable environment usually *scrutinize* on the waste and carbon footprint generated by various industries and often medical field are not included. The reduction of waste and carbon footprint contributed by medical industries can be achieved without neglecting health and wellbeing of humankind. It can be achieved by innovation of new age medical devices and sensors with applications of nanotechnology from collaboration works from various field of expertise.

Biography

Haotian CHEN is PhD candidate of Peking University, China. His research interests include stretchable device and self-powered system. I'm now focusing on fabricating stretchable devices

and designing new structure for self-powered system containing micro energy generator and strain sensor.

Kosuke MINAMI is postdoctor researcher of Japan National Institute for Materials Science (NIMS) His research interests are at the interface of synthetic organic, supramolecular, materials and biological chemistry, and molecular and cell biology. His previous study is on the drug and gene delivery systems, especially small interfering RNA (siRNA) delivery using cationic fullerene derivatives. By using the cationic fullerene derivatives, we achieved a lung-targeting delivery system of siRNA in vivo. His current study is on the synthesis of new fullerene-based nano- to microcrystals and its application for cellular scaffolds in tissue engineering, especially for controlling cellular morphology and differentiation.

TAN Wei Ming Alvin is Master Candidate of Nanyang Technological University, Singapore. His Research Interests focus on electrochemical deposition of nanostructure material for various applications such as Transparent conducting *electrodes, Gas sensing and super capacitor* applications. I had worked with potentiostat such as Gamry, autolab and solarton for pulse electrodeposition of nano structured functional coating.

Chirawat CHITPAKDEE is research assistant of National Nanotechnology Center (NANOTEC), NSTDA, Thailand. He is interested in development of new photo-functional materials for specific purposes especially for using as sensitizers in dye-sensitized solar cell (DSSC) and organic light emitting diodes (OLED. He works closely with experimentalists in development of such materials and apply them into the devices. With this strategy, the development of high efficient DSSC and OLED can be accelerated

Team: Dae Keun PARK(Korea), Rintaro HIGUCHI(Japan), Nor Dalila Abd RAHMAN(Malaysia), Jingwei

CHEN(Singapore), Chia Hua CHIEN(Taiwan), VU Thi Thu(Vietnam)

Introduction

Nur Aainaa Syafini Binti Mohd RADZI is innovation officeOf NanoMalaysia Berhad. As an Associate in a CLG carrying national mandates to promote the deployment and commercialization of nanotechnology products in Malaysia, her current interests are primarily on new technology available in the market, new innovation and commercialization activities happening worldwide, especially the one covered under NanoMalaysia Jumpstart Sectors. She is also interested in research activities related to environmental pollution prevention and control, especially on research related to PAHs and nanotechnology.Medical & Healthcare.

CAO Thi Thanh is PhD candidate of Institute of Materials Science, VAST, Vietnam. Her research interests include: Study and synthesis of single walled carbon nanotubes by thermal chemical vapor deposition and application in biosensor; study and synthesis of vertically-aligned carbon nanotubes by using thermal chemical vapor deposition and application in biosensor; Study and synthesis of graphene film on Cu substrate by using thermal chemical vapor deposition and application in biosensor.

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Industrial development has made our life more rich and convenient with population growth. However, industrials generated huge amount of pollutant (Table 1) spread in nature as a by-product at the same time, which cause serious damage to our body. In our project, we discuss the impact of nanotechnology to human life and industry, and also propose a novel sustainable system to deal with the environmental issues including water/air remediation, energy storage, and energy harvesting.

Heavy metal ions	Hg^{2+}, Cd^{2+}, As^{2+}, Pb^{2+} *etc.*
Toxic gases	SO_2, NO_x, CO *etc.*
Organic compounds	Pesticides and insecticides *etc.*
Industrial & domestic wastewater	Phenol, H_2O_2 *etc.*

Table 1 Contaminants generated from industrial development

Innovation - Impact of nanotechnology in our life and industry

Improved ability to detect and eliminate water/air contaminants

- Removal of greenhouse gases and other pollutants from the atmosphere
- Clean abundant power via more efficient solar cells
- Cleaner and more efficient industrial processes
- Decreased need for large industrial plants
- Remediating environmental damages

Proposal - Nanotechnologies for sustainable innovation

The "Greenhouse" phenomenon has been a globally urgent issue, which is mainly caused by the gas emission from cars and industrial plants. The gas emitted is mainly composed of some toxic gas, together with large amount of heat. Thus, in principle it is proposed that the heat can be harvested to power some sensors to adsorb the toxic gases.

Here, we proposed to establish "track processes" based on nanotechnology for purification of environmental contaminants (Fig .1). Track processes including energy storage/conversion, and real time monitoring of pollutants, can utilize to industrial processes. Specifically speaking, the heat can be transferred to electricity by a thermoelectric device, which can harvest electricity by a temperature difference. Then the generated electricity can be captured and stored by some energy storage devices, mainly battery and super-capacitors, which can store electricity by electrochemical reactions. Next, the electricity stored can be utilized to power the sensors, which can detect and adsorb the toxic gases emitted. Therefore, based on our proposal, the greenhouse effect of gas emission can be avoided and in an ideal case, the electricity harvested and stored can be applied to power other electrical devices. In addition, a nanotechnology-adopted sensor has great potentials as a simple and sensitive detection of pollutants due to simple conversion processes of chemical/electrochemical information to electrical signal and ability to integrate and miniaturize.

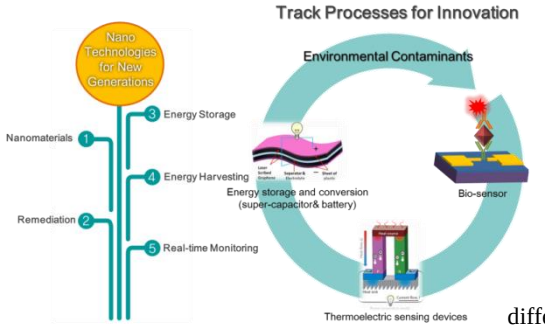
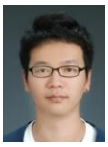


Figure 1 "Track processes" for innovation based on nanotechnology

Conclusion

The current problems of industry in the whole world have been considered as much of pollutants. We hope that nanotechnology based "Track processes" can improve the generation of environmental pollutants through rapid and continuous monitoring.

Biography:



Dae Keun PARK is currently a Ph.D. candidate in department of chemistry at Sungkyunkwan University (SKKU), Korea. His major research project is electrical/electrochemical biosensor using nanogap device.

Rintaro HIGUCHI is a postdoctor researcher in National Institute for Material Science (NIMS), Japan. His main research interests are electrical characterization of conductive polymer-based materials such as thin film and network.

Nor Dalila Abd RAHMAN is a Ph.D. candidate in Universiti Pendidikan Sultan Idris, Malaysia. Her main research is regarding the production of carbon-based materials that are vertically aligned carbon nanotubes (VACNTs) and carbon nanofibres using waste material from poultry industry that is waste chicken fat.

Jingwei CHEN is a Ph.D. candidate in School of MSE, Nanyang Technological University, Singapore. His main research is focuses on energy storage device including supercapacitor and sodium Ion battery.

Chia Hua CHIEN is currently a Ph.D. candidate in Taiwan International Graduate Program, Institute of Physics, Academia Sinica. His major research is thermoelectric materials synthesis and properties measurement.

VU Thi Thu is an assistant professor in departement of Materials Science and Nanotechmology Ha Noi University of Science and Technology, Viet Nam. Her research interests are concerned to Nanomaterials for biomedical applications, including metal nanoparticles and polymer thin films

✧ Asia Nanotech Camp 2016

Introduction

The Asia Nano Forum (ANF) is a network organization, founded in May 2004, to promote excellence in research, development and the economic uptake of nanotechnology within the Asian region. This collaborative network seeks to benefit its member economies educationally, socially, environmentally and economically by fostering collaboration and acting as a focus for regional and global nanotechnology issues. Asia Nano Forum (ANF) Network is supported by 15+1 economies in the Asia Pacific Region including Australia, Austria, China, Hong Kong, India, Indonesia, Iran, Korea, Japan, Malaysia, New Zealand, Singapore, Taiwan, Thailand, UAE and Vietnam.

Asia Nanotech Camp (ANC)

ANC is a program initiated by ANF, it serves as a platform for young researchers involved in nanotechnology to learn about the cutting-edge nanotech advancements, conduct site visits, experience collaboration with members from other economies by doing group projects which are evaluated by invited expert panellist. The participants are able to enjoy hospitality and local culture experience provided by the host.

The Asia Nanotech Camp (ANC) 2016 was held during April 3-8, in Vienna and Krems, Austria. This event was funded by Austrian Ministry of Transport, Innovation and Technology (BMVIT) and hosted by the University of Applied Sciences Krems (IMC), and co-organized by Austrian Academy of Sciences (OEAW) and ANF. The camp was co-located with the BioNanoMed2016 (bionanomed.at during Apr. 6-8, 2016) where ANC participants were able to participate in this specialized conference and learn about the cutting edge development of bionanotechnology. In addition ANC 2016 program includes a) site visits of leading research institutions in nanotechnology in Austria, b) workshop on Responsible Development of Nanotechnology Towards Sustainability through presentations of each participants' research topics and debates, and c) Workshop on Nanosafety and Nano Risk Governance-Asia, European and Austrian Perspective. Participants enjoyed visits of cultural and historical sites in Vienna and Krems in addition to meaningful social interactions with each other (especially between Asian and European participants) which you will be able to read in details in this issue of newsletter.

ANC2016

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Welcome Message from ANF Secretariat

Dear ANC2016 Participants,
Welcome to the Asia Nanotech Camp (ANC) 2016 to be held in Austria during Apr. 3-8th 2016!
The past Asia Nanotech Camps have created life changing experiences for our participants, and I trust we will create these experiences for you as well in this camp in Austria. You are selected to participate in the ANC 2016 as some of the most promising researchers in the field of nanotechnology, I would like to emphasize to you that it is critical that you develop the sense of responsibility and sustainability in your research and future career in nanotechnology and beyond. One unique feature of this camp is Nanosafety. I would like you to develop sufficient awareness and understanding of the issues of nanosafety, and implication as well as application of the research topics you are working on. During the one day ANC workshop, I would like you not only to share your research content, but more importantly your understanding on the application and implication of your research area.
Through the exercises of your presentations and debates during the camp as well as participating in the BioNanoMed2016 conference, you will learn the cutting edge nanomedicine R&D, nanotoxicology and nanosafety management as well as nanotechnology for sustainability. Being aware of social, environmental and economic aspects of sustainability helps you develop the holistic mind set in everything you do including your research career in nanotechnology. I will be one of your mentors during ANC2016 and I look forward to interacting with you and sharing with you my vision and practices in nanotechnology development towards sustainability.
Meanwhile, enjoy being in the beautiful Krems, Austria and the wonderful hospitality provided by our Austrian organising committee!

Lerwen LIU, PhD
Founding Secretary of Asia Nano Forum
Email: lerwen@nano-globe.biz

Welcome Message from Austrian Organizer

Ladies and Gentlemen,
Dear colleagues,
Nanotechnology is an emerging technology and can - like every new technology - be discussed in several contexts. The public debate in the European Union was initially polarised between high economic expectations on the one hand and severe risks for human health and environmental integrity on the other. To improve the open debate in the public and to contribute to the qualified formation of opinion the European Commission published an Action Plan on Nanotechnology, which rests on three pillars: (1) establishing an independent safety research, (2) developing a transparent communication strategy in public, and (3) setting up international networks to foster both. According to the Precautionary Principle these approaches are meant to ensure the "safe and responsible development of nanotechnologies", as the EUC puts it. Of course, all these activities had a perceptible influence on nanotechnology research in the EU member states. The Austrian Nanotechnology Action Plan for example contains over 50 recommendations regarding the realisation of the three pillars of nanotechnology development set forth by the European Commission, such as the establishment of an Austrian EHS-research programme, the launch of a nano information portal, and the foundation of a national scientific commission on nanosafety issues, the Austrian Nano Information Commission (NIK) of the Austrian Ministry of Health.
For the first time, the Asia Nanotech Camp will take place outside the Asian world. It is a great honour and an undisputable pleasure for the organiser to welcome all young colleagues who have decided to participate in the activities of the Campus and the adjacent events taking place in Vienna and Krems/Danube. The Asian Nano Forum and its campus have evolved in recent years as a lively platform for exchanging knowledge and a certain culture of scientific labour. This year the main motto will be sustainability and safety of nanotechnology development and the organisers hope insistently that the spirit of the recent years which filled the Asian Nano Campus will constitute a sustainable presence also in Austria.

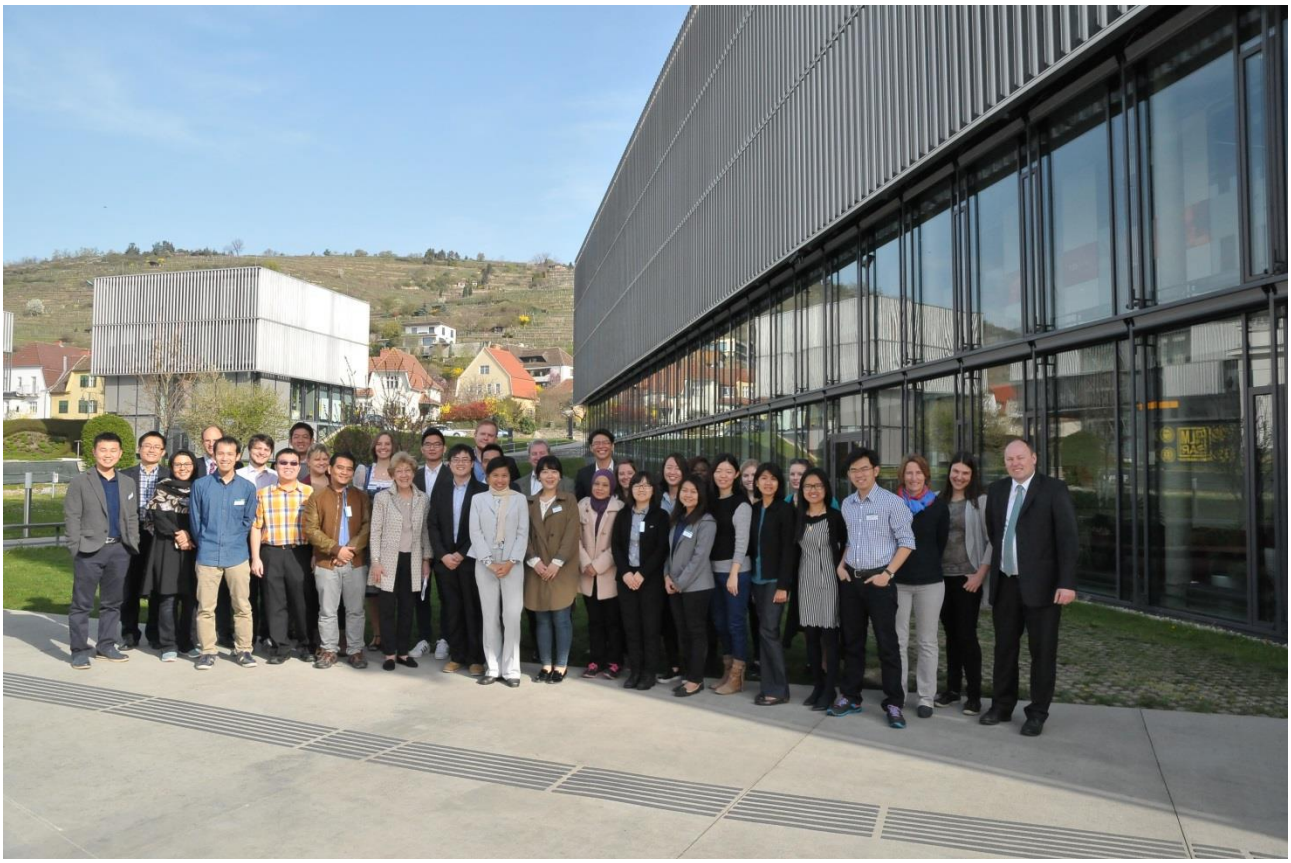
Dr. André Gazsó
Austrian Academy of Sciences
Head of the Austrian Nano Information Commission

Welcome Message from Austrian Host

It is a great pleasure to welcome all participants of the 9th Asia Nanotech Camp (ANC 2016) to Krems/Danube on behalf of the Organising Committee and the University of Applied Sciences Krems. In the first week of April 2016 the picturesque old town of Krems will be a hotspot for nanotechnology and life science technologies, since several conferences in the above mentioned fields will take place in parallel. Well established researchers, young scientists and students from many different countries have the opportunity for discussion and networking. In case of the University of Applied Sciences Krems (IMC) on focus point is internationalization. Therefore, we are proud to host scientists from many countries such as Australia, China, Hong Kong, Iran, Japan, Korea, Malaysia, New Zealand, Singapore, Taiwan, Thailand and Vietnam. I wish all participants a pleasant, memorable and fruitful stay in Austria and varied opportunities to make new experiences, meet friends and establish collaboration opportunities. It is important to bear in mind that innovation is best generated when different disciplines exchange ideas and start to cooperate. And last, but not least, all participants are invited to explore the well-known UNESCO World Heritage Site area around Krems "Wachau Cultural Landscape".

Prof. (FH) Mag. Dr. Harald Hundsberger
Department Head Life Sciences
Vice Chair of the Academic Board
IMC Fachhochschule Krems University of Applied Sciences Krems

Gallery



Group photo of ANC2016

Site-visits

Workshop

Program

Day 1: April 03, Sunday		
	Arrival of participants at Vienna airport, Individual transfer to Vienna	No airport pick up will be provided. The instruction of transfer was sent separately.
	Check-in at the hotel "Ibis Messe Wien" for 1 night	Students who arrived before April 3 could book same hotel by email by 21st Feb., using the code word "ANC2016", pay by self. Contact details: Marko Muzyczyn, E-Mail: H7098-DM@accor.com Tel: 0043 1 212 0424 630 http://www.ibis.com/gb/hotel-2736-ibis-wien-messe/index.shtml
19:45	Meeting at hotel lobby and transfer to the restaurant "Einstein"	http://einstein.at/cms/uk/ Rathausplatz 4, 1010 Vienna Tel.: +43 1 4052626 Travel Information on how to get to the restaurant were sent separately.
20:00	Welcome dinner	

Day 2: April 04, Monday		
08:45	Meeting at the hotel lobby	
09:00	Departure for the site visits in Vienna (Technical University Vienna, Austrian Institute of Technology), bus transfer	All luggage has to be to be taken to the bus, there will be no return to the hotel
09:15	Site visit Institute of Molecular Diagnostics of Austrian Institute of Technology	Institute of Molecular Diagnostics Dr. Rudolf Heer, Tech Gate Vienna, Donau-City-Strasse 1, 1220 Vienna http://www.ait.ac.at/departments/health-environment/molecular-diagnostics/
11:00	Bus transfer to Vienna Technical University	
11:30	Site visit Technical University of Vienna	Institute of Solid State Electronics, Prof. Gottfried Strasser, Floragasse 7, 1040 Vienna http://fke.tuwien.ac.at/e362_home/EN/
13:30	Lunch at the institute	
14:45	Departure for sightseeing tour – Vienna Schloss Schönbrunn	http://www.schoenbrunn.at/en.html
15:30	Sightseeing tour Schloss Schönbrunn	Guided tour in the castle
17:00	Bus transfer to Krems	Hotel Unter den Linden, Schillerstraße 5, 3500 Krems an der Donau E-Mail: hotel@udl.at, Tel. 0043 2732 82115 http://www.udl.at/cms/
18:30	Arrival at Krems Hotel "Unter den Linden" – check in	
19:45	Meeting at hotel lobby and short walk through Krems old town	Wiener Straße, A-3500 Krems/Donau, Gasthof: +43 2732 82143 http://www.klinglhuber.com/web/index.php/start.html
20:00	Dinner at Krems restaurant „Klinglhuber"	

Day 3: April 05, Tuesday Asia Nanotech Camp (ANC 2016, Austria) Workshop Venue: Wing G, Room E.12	
09:15	**Welcome Address** Alexander POGÁNY, MSc., Austrian Ministry for Transport, Innovation and Technology (BMVIT)
09:25	**Welcome Address** Prof. Eva WERNER, Headmistress of IMC
09:35	**Introduction to the workshop topic, Safe and Sustainable Development of Nanotechnologies &**

	Responsible Innovation Towards Sustainability Dr. André GAZSÓ, Austrian Academy of Sciences Dr Lerwen LIU, Founding Secretary of Asia Nano Forum	
10:05	**Session I** – 8 presentations, 5-8 mins each	Chair: Daniela FUCHS, MSc.
11:05	Coffee Break	
11:20	**Session II** – 10 presentations, 5-8 mins each	Chair: Dr. André GAZSÓ
12:50	Lunch	
13:45	**Session III** – 9 presentations, 5-8 mins each	Chair: Alexander POGÁNY, MSc.
15:15	Coffee Break& Group Break out for Debate Preparation	Chair: Dr. Lerwen LIU & Dr. André GAZSÓ
16:15	Debate: **Nanotechnology Application and Implication (benefits vs risks)**	Moderator: Dr. André GAZSÓ
16:45	Debate: **Sustainability Driven Innovation (technology vs me)**	Moderator: Dr. Lerwen LIU
17:15	Summary of discussions & End of workshop	
	Evening at own disposal	

Day 4: April 06, Wednesday European Perspectives and Asian Approaches to Nanosafety - OEAW/NIK Workshop within ANC 2016 Krems Venue: Wing G, 1st floor, Room E.25+26	
09:00	Welcome and Introduction: **Nanosafety and Concepts of Nano Risk Governance** Dr. André GAZSÓ, Austrian Academy of Sciences & Austrian Nano Information Commission
09:15	**The Role of Safety and Trust in Promoting Global Benefits of Responsible Nanotechnologies: Thailand's Perspective** Prof. Sirirurg SONGSIVILAI, National Science and Technology Development Agency, Thailand
10:00	**Detection of Engineered Nanoparticles Nanoparticles in Water, Soil and Sediments: from Bulk Analysis to Single Particle ICP - TOF - MS** Dr. Antonia PRAETORIUS, University of Vienna
10:30	Coffee Break
10:45	**Nanomaterials in the Environment - the Role of Waste Management** Prof. Marion HUBER-HUMER, University of Natural Resources and Life Sciences, Vienna
11:15	**Nanocrystals: from Synthesis to Applications as Tracer Materials** Prof. Eva SINNER, University of Natural Resources and Life Sciences, Vienna
11:45	**Nanotracers - a case study to elucidate the environmental fate of nanomaterials** DI Florian PART, University of Natural Resources and Life Sciences, Vienna
12:15	Lunch break
13:15	**Innovation and Safety in Austria: A Survey of Austria´s Regulatory and Funding Activities in the field of Nanotechnology Safety** DI Alexandra KUHN, Austrian Research Promotion Agency
13:45	**Nanosafety within the Context of EU Legislation on Consumer Protection** Mag. Lisa URBAN, Austrian Ministry of Health
14:15	**Developing Responsible Mind-set in Nanotechnology Enabled Innovation Towards Sustainability** Dr. Lerwen LIU, Asian Nano Forum
14:45	**Summary and Outlook** Dr. André GAZSÓ
15:00	**End of nanosafety workshop**
15:00	Coffee Break
15:30	Prof. DI Bernhard KLAUSGRABER & Prof. Dr. Barbara ENTLER, IMC **Introduction to IMC site visit: Presentation on the Department of Life Science at IMC** Meeting Point: Room GE12.
16:00	IMC Site Visit: guided tour of IMC laboratories
17:00	End of site visit (approx.)
19:15	Meeting in front of Wing G to walk to the restaurant
19:30	Dinner at Stadtheurigen Müllner — Stadtgraben 50, A-3500 Krems/Donau http://www.weingut-muellner.at/en/aktuelles/heuriger_muellner;

Day 5: April 07, Thursday		
09:00 – 17:00	BioNanoMed Conference	The students are free to visit the conference, the conference fee will be paid by BMVIT and is part of the ANC

Day 6: April 08, Friday		
09:00 – 13:00	BioNanoMed Conference	The students are free to visit the conference, the conference fee will be paid by BMVIT and is part of the ANC
14:00	Meeting for common transfer to Vienna City	Train departure in Krems: 14:51.
	Individual departure from Vienna City to the Vienna Airport	Students will be escorted to Vienna Landstraße (arrival approx. 16.15) where they can take the S-Bahn 7 or CAT to Vienna Airport (approx. 20-45 min)

Group Debate: "Sustainability and Me"

Purpose

Share understanding of the pros and cons of nanotechnology innovation towards sustainability and how you, as an individual, should bear the responsibility of contributing to sustainability of our planet. You are expected to learn during ANC2016 that technological and even business innovation is not sufficient for solving the world's problem. Keep in mind that you, as a consumer or being in different part of the product ecosystem, are able to make a big difference transforming our world today having a responsible and holistic mind set.

Topics

Each group is assigned one of the below topics & sides for debate. Each participant must select one of the perspectives to prepare the debate and present his/her views.

Topic 1: Nanotechnology Application and Implication (benefits vs risks)
Topic 2: Sustainability Driven Innovation (technology vs Individual)

Format of Debate

All participants will be divided into 4 groups and each will be assigned randomly one side of one debate topic.
Total of 2 hours including one hour group brainstorming and 30 minutes debate on each topic
Semi-formal: a) Introduction, b) Presenting key points, c) Presenting counter arguments, d) Summary

Tips

Those who choose 1) Nanotechnology Application (Benefit) and 2) Sustainability Driven Innovation (Technology), could focus on how technology innovation is able to transform our way of life and change how things are made in a more sustainable way, again "use less for more", disrupting business, creating new opportunities for entrepreneurs, empowering individuals to take life in their own hands in energy, water, etc.
Those who chose 1) Nanotechnology Implication (risks) and 2) Sustainability Driven Innovation (Individual), could think holistically the technology innovation ecosystem (integrate all stakeholders) and product manufacturing value chain, identify responsibilities of "me" in different part of the innovation ecosystem. Also conduct preliminary research on nanosafety issues and address the implication of nanotechnology in human/animal health and environment.

Mentors

Dr. Lerwen LIU, Founding Secretary of ANF, lerwen@nano-globe.biz
Dr. André GAZSÓ, Chairman, Austrian Nanotechnology Information Commission of the Austrian Ministry of Health, agazso@oeaw.ac.at

	Names		**Country**	**Topics/Sides**
A	Mona Nur Aimi Binti Mohd Fung Ling Xiuguo Dai Hai Daniel Natee	ALIBOLANDI NASIR YAP CHEN NGUYEN GRBAC WONGSRISUJARIT	Iran Malaysia Singapore China Vietnam Austria Hong Kong	**Nanotechnology Application (Benefits)**
B	Aeyeon Nicole Thi Thu Xiaoliang Ali Khairul Anuar Abd Tsung-Ju	KANG HUBER VU CHEN ZARRABI WAHID LI	Korea Austria Vietnam China Iran Malaysia Taiwan	**Nanotechnology Implication (Risks)**
C	jieun Lee Kheng Pattarapond Weiyang Gaku Patrick	SIM TAN GONIL CHEN IMAMURA RERICHA	Korea Singapore Thailand Hong Kong Japan Austria	**Sustainability Driven Innovation (Technology)**
D	Eun Ji	YOO	Korea	**Sustainability Driven**

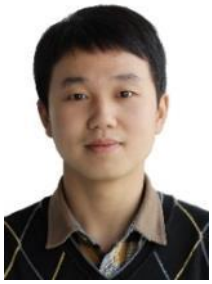
	Nurul Asyikin	KAMARUZAMAN	Malaysia	**Innovation (Individual)**
	Isabella	WINTER	Austria	
	Takao	TSUMURAYA	Japan	
	Shun-Min	YANG	Taiwan	
	Noppadol	AROONYADET	Thailand	

***Note that all teams, coordinators and topics were selected randomly.**
*** You are encouraged to start contacting and working together via emails on your debate from now. The contact information of your team members will be send to you explicitly.**

Participants and ANC 2016 Reflections

China

Xiaoliang CHENG, PhD Candidate
Institute of Microelectronics, Peking University
E-mail: xlcheng@pku.edu.cn
Keywords: Power MEMS, Energy Harvesting, Nanogenerators, Flexible Materials, Manufacturing of Micro/ nano Structures.



Research Interests:
My research interests are micro energy harvesters based on triboelectric and electrostatic transduction mechanisms. I'm now focusing on the study of high performance triboelectric nanogenerator (TENG) based on a novel single-step fluorocarbon plasma treatment-induced wrinkle structure. As a substitute for traditional power supply, harvesting energy from the environment is an effective way to power wireless sensors, implantable electronics and other low power consumption devices. TENG is gradually becoming a very promising method in the field of energy harvesting. My work focused on improving the output performance of TENG by wrinkle structure with single-step fluorocarbon plasma treatment. This method could introduce the material modification and wrinkle structure in single step, resulted in greatly enhancement of the electric performance of TENG. Additionally, I try to control this novel manufacturing process for wrinkle structure at present, which may lead to further increment of TENG's performance.

References:
[1] Xiaoliang Cheng, Bo Meng, Xiaosheng Zhang, Mengdi Han, Zongming Su, Haixia Zhang, Wearable electrode-free triboelectric generator for harvesting biomechanical energy, Nano Energy 2015, 12, 19-25.
[2] Xiaoliang Cheng, Bo Meng, Xuexian Chen, Mengdi Han, Haotian Chen, Zongming Su, Mayue Shi, Haixia Zhang, Single-step fluorocarbon plasma treatment-induced wrinkle structure for high-performance triboelectric nanogenerator, Small 2016, vol. 12, 229-236.
[3] Xiaoliang Cheng, Xuexian Chen, Bo Meng, Mengdi Han, Mayue Shi, Haotian Chen, Yu Song, and Haixia Zhang, A flexible and wearable generator with fluorocarbon plasma induced wrinkle structure, in Digest Tech. Papers MEMS'16 Conference, Shanghai, January 24-28, 2016, pp. 1181-1184..

Abstract of Presentation:
This work presents a flexible and wearable energy harvester for harvesting muscle motion energy. A novel single-step fluorocarbon plasma induced wrinkle structure is employed as the friction layer to increase its performance by enlarging the contact area and introducing material modification at the same time. Under bending or pressing, this device could produce an alternating current. Additionally, by adjusting the spin-coating speed, this wrinkle morphology and the thickness of PDMS (polydimethylsiloxane) film could be controlled. Therefore, through the optimizing of this parameter, 225 V peak voltage and 375 μA maximum current is achieved under finger typing. Moreover, this device is successfully mounted on an adult's arm to scavenge the mechanical energy during his motion. Due to its well flexibility, simple manufacturing process, and high output performance, the generator has much potential for powering up wearable electronics or e-skin.

Reflections
As the main organizer said, it was the first time that the Asia Nanotech Camp took place outside the Asian world. Also it was my first time to take part in this activity. The Asian Nanotech Camp 2016 lasted for about 5 days. We took part in many meaningful activities during these days which were elaborately prepared by the organizer. In the first day, we visited the Austria Institute of Technology and listened to the research work of this institute in the morning. They did a way impressive work that could form system by different individual working together. And they even established a connection bridge between their sensors and smart phone. It was really convenient and greatly helpful for the practical applications, which represented the future trend for patient to heal themselves at home. The logo, Tomorrow Today, of this institute also impressed me a lot. Though I don't know the exact meaning, I think they are pushing themselves to harder work for a better life in the future. Then we went to the Institute of Solid State Electronics of Technical University of Vienna and visited their clean room. It was surprised to know that they got no fund from the government, but from the companies instead. Nearly all the machines and equipment in their clean room were donated by companies for they could cooperate with each other to solve some real problem in the companies or in research. In this case, the researchers could know what they should do that was needed in the industries while the industries were able to put the newest technologies into use at the first time. Afterwards, we were transferred to the Krems, a small but beautiful city near to Vienna.

In the second day in Krems, we began our presentations and the debate. The arrangement for this day was really compact. Nearly 30 people need to give their presentations in about three hours. After roughly listened to the presentations, the debate was begun and our group would talk about the risk of nanotechnology in this debate. I put forward the reliability and cost issue that may be taken by the nanotechnology. We cooperate very smoothly with each other and make a clear division of labor in the discussion. Then our leader Kelvin from Taiwan made a very successful debate, and expressed our opinion extensively. We were really proud of him.

It's really different to take part in this camp compared with to take part in an international conference. Since you can talk more and have longer time to get along with your partners from different counties. The talk was not just about academic topics, we would also talk about our cultures and something interests. Therefore, we could learn more from each other and learn how to cooperate with a foreigner. It's also very successful that the Asian nanotech camp took place outside Asia. Since I think there are too many commons in Asian people no matter you are from China, Korea, Japan, Singapore, and so on. We need to learn from other continents with

distinguished characters. And Asian is still a follower in the development of many technologies; we still need to learn something from European or US.

Xiuguo CHEN, PhD Candidate
School of Mechanical Science and Engineering, Huazhong University of Science and Technology
E-mail: xiuguochen@hust.edu.cn
Keywords: Nanometrology, Optical Scatterometry, Ellipsometry, Computational Electromagnetics, Inverse Scattering Problem.

Research Interests:
My research interests focus on theory, instrumentation, and application of ellipsometry, especially Mueller matrix ellipsometry, for nanoscale characterization.

- *Theory*: physical and mathematical interpretation of Mueller matrices, including computational electromagnetics of nanostructures (e.g., EMA, RCWA, BEM, and FEM), Monte Carlo modeling of polarized light propagation in turbid media, and Mueller matrix decompositions etc.
- *Instrumentation*: development of Mueller matrix ellipsometers, including broadband Mueller matrix ellipsometers with spectral range extended to ultraviolet, infrared, and terahertz band, advanced Mueller matrix ellipsometers combined with imaging, interferometry, and tomography techniques etc.
- *Application*: application of the above theory and instrument to explore the physical, chemical, and biological mechanisms at the nanometer scale, including the application to characterize nanostructures, metamaterials, metasurfaces, chiral materials, turbid media, and biological tissues etc.

References:
[1] Chen, X. G., Zhang, C. W., and Liu, S. Y. (2013) Depolarization effects from nanoimprinted grating structures as measured by Mueller matrix polarimetry, Applied Physics Letters, 103(15), 151605.
[2] Chen, X. G., Liu, S. Y., Zhang, C. W., Jiang, H., Ma, Z. C., Sun, T. Y., and Xu, Z. M. (2014) Accurate characterization of nanoimprinted resist patterns using Mueller matrix ellipsometry, Optics Express, 22(12), 15165-15177.
[3] Chen, X. G., Jiang, H., Zhang, C. W., and Liu, S. Y. (2015) Towards understanding the detection of profile asymmetry from Mueller matrix differential decomposition, Journal of Applied Physics, 118(22), 225308.

Abstract of Presentation:
In order to achieve effective process control, fast, inexpensive, nondestructive and reliable nanometer scale feature measurements are extremely useful in large-scale nanomanufacturing. Among the possible techniques, optical scatterometry is relatively ideal due to its high throughput, low cost, and minimal sample damage. Compared with conventional optical scatterometry, which is usually based on reflectometry and ellipsometry and obtains at most two ellipsometric angles, Mueller matrix ellipsometry (MME) can provide all 16 elements of a 4□4 Mueller matrix, and consequently, MME-based scatterometry (also called the Mueller matrix scatterometry) can acquire much more useful information about the sample and thereby can achieve better measurement sensitivity and accuracy. In the presentation, the basic principle and instrumentation of MME as well as the data analysis in MME-based nanostructure metrology are presented. Several case studies are finally provided to demonstrate the great potential of MME in nanostructure metrology, which include the measurement of e-beamed patterned grating structures, the measurement of nanoimprinted resist patterns, and the measurement of etched trench nanostructures that are typically encountered in the manufacturing of flash memory storage cells.

Reflections
My name is Xiuguo Chen, from Huazhong University of Science and Technology, Wuhan, China. It is very luck for me to attend the 9th Asia Nano Camp (ANC 2016) hold at Vienna and Krems, Austria. During the camp, we first visited the Institute of Molecular Diagnostics, Austrian Institute of Technology and the Technical University of Vienna. During the site visit, it's a great honor for me to listen to a report presented by Dr. Rudolf Heer at the Austrian Institute Technology, which made me learn a lot about the biomedical diagnostics, lab-on-a-chip systems and nanobiosensors etc. We were also guided to visit and learn the cleanroom facilities of both Austrian Institute of Technology and Technical University of Vienna. At the end of April 4th, we had also a sightseeing tour to the Vienna Schloss Schönbrunn, a very famous site of Vienna.

The debate on "Nanotechnology Application and Implication; Sustainability Driven Innovation – Technology and Me", also the theme of this ANC 2016, began on April 5th at the IMC University of Applied Science, Krems. I was in Group A, whose topic was on the benefits of nanotechnology application. Our summary on this topic mainly discussed the benefits of nanotechnology application in medicine, environment, and energy. Here, I also want to talk about another benefit of nanotechnology, that's the computer in our daily life. We are now quite familiar with our personal computer, which is very portable and has a small size but has a very strong computing power. However, we might not quite familiar with the first electronic general-purpose computer, ENIAC (Electronic Numerical Integrator And Computer), which was invented in 1946 and weighted more than 27 tons and was roughly 2.4m0.9m30m in size and occupied 167m2. Even it is so heavy and so large, its computing power is even inferior to our current personal computer, which is indeed attributed to the development of nanoscience and nanotechnology and is also a benefit of nanotechnology application in my opinion.

I think that the main inspiration for me gained from this camp is a thorough consideration about a new technology. Before this camp, I always believe that nanotechnology will undoubtedly have many benefits for everything, which was also the motivation when I decided to pursue my Ph.D. degree on nanotechnology. However, from this camp, especially after listening to several lectures presented by Dr. Ardré Gazsó, Prof., Sirirurg Songsivilai, and Prof. Marion Huber-Humer etc., I realized that even a seemingly good thing will have its potential risks hidden in its behind, just like an old saying said "every coin has two sides". I think I will pay much attention on another side of nanotechnology during my future research. Finally, I also want to say that the ANC is really a very good and interesting camp. Except learning a lot about nanotechnology, it is a great honor for me to discuss with so many partners from different areas and countries with different backgrounds. I sincerely hope that I can have another chance to attend the next camp.

Hong Kong

CHEN Weiyang, PhD Candidate
Department of Chemical and Biomolecular Engineering, The Hong Kong University of Science and Technology
E-mail: wchenao@ust.hk
Keywords: Graphene, metal oxide framework, aerogel, air treatment

Research Interests:
My research addresses the pollutants in indoor air including malodors and bioaerosols. Primarily I have been working on the design and synthesis of freestanding graphene and MOFs aerogels for air treatment. Additionally, I am interested in introduction different kinds of nanomaterials into the network of graphene aerogels by using different kinds of cross-linkers, like ethylenediamine, PEI and also silk protein.

References:
[1] H. Hu, Z. Zhao, W. Wan, Y. Gogotsi, and J. Qiu, "Ultralight and highly compressible graphene aerogels," Adv. Mater., vol. 25, no. 15, pp. 2219–2223, 2013.
[2] H. Hu, Z. Zhao, W. Wan, Y. Gogotsi, and J. Qiu, "Polymer/graphene hybrid aerogel with high compressibility, conductivity, and 'sticky' superhydrophobicity," ACS Appl. Mater. Interfaces, vol. 6, no. 5, pp. 3242–3249, 2014.
[3] X. Xu, H. Li, Q. Zhang, H. Hu, Z. Zhao, J. Li, J. Li, and Y. Qiao, "3D Graphene / Iron Oxide Aerogel Elastomer Deformable in a Magnetic Field," pp. 3969–3977, 2015.

Abstract of presentation
Bioaerosols, malodors and VOCs are important pollutants found indoor. They are known to cause discomfort and irritations, and are linked to many illnesses, both chronic and acute. Current air purification technologies based on air filtration and adsorption are far from satisfactory due to poor system integration, high energy consumption and secondary pollution.
This work attempts a new approach in the design of air purification system by direct integration of the particulate filtration, bioaerosol disinfection, malodor adsorption and catalytic conversion at the material level.
Graphene-MOFs aerogels were prepared by crosslinking graphene and metal oxide frameworks, and create a new composite porous network of enormous surface area for efficient particulate and gaseous pollutant captures. Graphene aerogel can act as a matrix for immobilization and assembly of MOFs, which could efficiently minimize the potential release of MOFs into the environment. The freestanding aerogels are formable and possess good mechanical strength. Active catalysts for oxidative treatment of VOCs, NH3 and H2S can be dispersed on the new aerogel materials. The graphene-MOFs aerogels are intrinsic bactericides and capable for reducing viability of airborne bacteria.

Reflections
First of all, I would like to express my grateful thanks to all the organizers, especially Dr. Lerwen and Dr. Andre, and it is a great honor for me to join such a fantastic event, Asia nanotech camp 2016. It gave me a chance to go to the Austria and experienced the different culture and lifestyle there. Vienna is a gorgeous, vibrant, historic city with many beautiful churches and museums, which impressed me a lot, especially when we are visiting the Palace and gardens of Schonbrunn. In addition, we also visited some universities in Vienna, and they introduced some technologies and equipment which inspired me a lot. And the workshop also made me think about the nanosafety and sustainability issues of my own research which I never thought of before. It is essential for me to think about the potential risk part in my research at an early stage.

Also, I joined the debate activity, which I never tried before and talked about the sustainability issues, whether is driven by technological innovation or individual innovation. From the debate point of view, firstly, I believe all the problems we meet today concerned with the sustainability issue should be and only be solve be technological innovation. Secondly, in the past, we didn't use internet and even smart phone, however, the technological innovations happened and changed our daily life, which enable us to live a better life, and living a better life is a significant part of sustainability. However, as a researcher, I think we should be aware of the potential risk part of the technology and implications of nanotechnology, and I really impressed by someone said in the debate section that the best way to fight against the risk is stop fighting with each other.

During the camp, I made a lot of friends, and we really enjoyed a wonderful time during the six days in Krems, a really beautiful old town near Vienna. And all of us learned a lot from the workshop and conference held there. ANC 2016 gives us an opportunity to think about our research project from a totally different and interesting angle, and inspire us to look at the other side of the coin. Maybe at the beginning we only care about the benefits and applications of our research. And actually, when we start to look back and think of the potential risks, which will, in turn, to help us to make our projects much more meaningful and sustainable.

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Keywords: Artificial Photosynthesis, Photocatalysis, CO2 reduction, Titanium Oxide, Electrophotochemical cell

Research Interests
My research area focuses on the development of photocatalyst for applications in CO2 reduction to produce hydrocarbon fuels. This CO2 reduction process by photocatalyst is also known as artificial photosynthesis. Currently, I am working on the synthesis and modification of titanium oxide based photocatalyst in order to increase the light capturing efficiency. By doping the titanium oxide photocatalyst with other elements, the light capturing efficiency was shown to be enhanced.
In addition, I am also interested in the design of a electrophotochemical devices for efficicient production of energy from the sunlight.

Abstract of Presentation:
As a consequence of rapid growing world population, the global energy demand was increasing drastically, and is forecasted to be doubled by 2050. Currently, more than 70% of global energy relies on the use of fossil fuels, while the remaining are on the use of nuclear and other renewable energy resources. The use of fossil fuels, however, release large amount of CO2, which is a geenhouse gas that causes global warming. The use of fossil fuel will certainly deteriorate the environment. Therefore, the searching for more sustainable and environmental friendly energy sources in crucial.
Artificial photosynthesis is the process of capturing energy from sunlight to convert CO2 into energy stored compounds that can be used as fuels. The process requires a photocatalyst that can efficiently capture energy from sunlight and drive the CO2 reduction reaction with water. Titanium oxide is one of the photocatalysts that receives great attention due to its high stability, high oxidation power, low material cost, and non-toxic nature. However, titania catalyst require high excitation energy from UV light, which make it inefficient for operation under sunlight. The objective of my research is to develop the titania based catalyst to improve light capturing efficiency.

Reflections
It is really a good experience for me to visit Austria. Actually this is my first time visiting other country outside Asia. Thank you so much to the ANC organizing team for providing me a very good opportunity. I also really appreciate Prof. Andre Gazso and his team for his great accommodation of our trip. On the first day, we have a chance to visit the Austrian Institute of Technology and the Vienna Technical University. The research institutes have very good facilities and equipment for doing researches. They have a big clean room with good conditions for working with delicate fabrication of nanomaterials. It is a good opportunity for me to observe closely the researchers who are working in their labs. I also learned about their research through their presentations. The overall idea I perceived about their researches is that the researches are working intensively on the fabrication on nanomaterials for applications in environment, biology and medicine, and it is interesting to me. After that we went to the IMC University of Applied Sciences Krems to visit their labs and conduct our activities. The University is situated in a very good environment and I really love it–Krems is a very peaceful and quiet town, and the environmental condition is quite good as can be seen from the clean Danube river and many trees around the area and on the mountain. At IMC University of Applied Sciences Krems, I know many new friends from different countries through various activities and by going out together for visiting sight-seeing places.

For our activities, we first introduced ourselves through presentations and then had a debate on nanotechnology. I feel interested and fun during our debate activity, in which we can share our ideas with our friends and make a discussion. On my side, I am working on the advantages of nanotechnology. In my opinion, I believe that everyone has a very good ideas on how can nanotechnologies bring so many advantages to our lives. However, on the other hand, if we ignore about the safety and their side effects, it can be dangerous to our lives and to the environment we are living in. Sometimes when we have new technology, we will not be able to know its bad effect in the real situation (we need an experience so that we can learn). Nanomaterials are different from bulk materials that we can find easily in environment. What we can do at our best is just predicting the risk of the technology based on the known toxicity of our starting material for example. During the lecture, I am interested in the lecture on how we can trace the pollutants in our environment. The researchers studied about the background concentration and the present concentration of pollutants to obsrerve their spreading. I think this is important because it will give us a good overall idea about how much we pollute the environment, and this will serve as a driving force for us to think about how will we manage the pollutant (setup policy, waste management) and adopt it to our researches.

Apart from the researches, site visits, and activities, I also learned about the Austrian history during our visit to the Schloss Schönbrunn Palace. The buildings in Vienna and Krems are so classic. They have a good town preservation strategy that can harmonize with the developing world. I went to the church in Krems that was older than thousand years ago. It is still in a good condition and maintains its beautiful decoration inside. In addition, I am also impressed with the local and other European people. They are very kind and friendly. When I faced with some difficulties or getting lost they are always willing to help me. To conclude, I have a very good impression during my visit to Austria.

Iran

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Keywords: Nanobiotechnology, Nanomedicine, Nanotheranostics, Drug Delivery System, Nanofood

Research Interests:
Ali Zarrabi is Assistant Professor of Nanobiotechnology at Faculty of Advanced Sciences and Technologies, University of Isfahan.
Ali Zarrabi received his BSc in Chemical Engineering from Isfahan University of Technology on 2004 and his MSc in Chemical Engineering, Biotechnology from Sharif University of Technology on 2007. Then he obtained his PhD of Nanobiotechnology from Sharif University of Technology on 2011. From then, he has served as Assistant Professor in the Department of Biotechnology of University of Isfahan. His main research interests are Nanobiotechnology, Nanomedicine, Nanofood, Simultaneous Drug Delivery and Diagnosis (Theranostics), Nanotheranostics, Targeted Drug Delivery, Cancer Therapy, Dendritic & Hyperbranched Polymers. Since 2014, he has published more than 15 research articles in international peer-reviewed journals, including *Food Hydrocolloids, RSC Advances, Food Chemistry and Journal of Materials Science: Materials in Medicine*.

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Abstract of Presentation:
My research is in the field of Nanobiotechnology. I have been working on Nanomedicine and Drug Delivery Systems specifically to defeat cancer cells. Our main strategy is to design and fabricate a delivery system based on Metal Oxide or Carbon materials as the core structure shielded with a biocompatible polymer. The core structure acts as an imaging agent or drug loading enhancer, while the polymeric shell could improve the biocompatibility of the system as well as drug loading. The target cells are mainly breast cancer cells and prostate cancer cells. We have mainly focused on herbal drugs as active agents instead of chemical toxins, since natural molecules have proven to be less harmful to the healthy tissues and cells.
Besides drug delivery systems, we have done several researches on nano-diagnostics systems specifically imaging systems. Our research includes simultaneous drug delivery and imaging, which is summarized by "Nano-theranostics". Using a metal oxide nanoparticle as the core and a biocompatible polymer as the shell enables to load drug inside polymeric shell while registering images from the target tissue.

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Keywords: Self-assembly, Polymeric nanoparticles, Polymersome, Aptamers, In vivo tumor model

Research Interests:
I have MSc degree in Microbial Biotechnology and PhD degree in Medical biotechnology from Mashhad University of Medical Sciences. For the last four years I have been working in Pharmaceutical Research Center and made significant contributions in the field of targeted drug delivery to cancer stem cell, tumour imaging for diagnostics and *in vivo* tumour models. My research at Mashhad University focuses on targeted cancer chemotherapy; reduce toxicity of routine cancer therapeutics through encapsulation in nanoparticulate systems and *in vivo* tumour imaging. Studies on cancer stem cells and effectively targeted cancer therapy plays prominent role in my career goals.
Now a day, chemotherapy in cancer treatment is not only about killing of cancerous cells, but rather the main goal is; targeting tumours' initiators which induce metastases and tumour relapses. Cancer stem cells are usually resistant to chemotherapy. Due to this reason, application of novel drug delivery systems which can target these cells has been an attractive route in cancer chemotherapy. In my PhD thesis, biodegradable PEG-PLGA nano-carrier was synthesized and implemented for anti-cancer drug delivery. This system was conjugated to EpCAM aptamer (EpCAM is a specific marker on the surface of cancer stem cells). The characteristics and efficacy of this novel targeted drug delivery system was evaluated *in vitro* and *in vivo* in non-small cell lung cancer nude mice model.

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Abstract of Presentation:

Theranostic systems have drawn great attention for the past few years due to their wide applications in biomedical research. In this contribution, we demonstrated the design and delivery of tumor-targeted, quantum dot (QD) and doxorubicin (DOX)-encapsulated PEG-PLGA nanopolymersomes (NPs) for the imaging and chemotherapy of breast cancer. To achieve active cancer targeting, QD and DOX–encapsulated NPs were conjugated with folate for folate–binding protein receptor–guided delivery, which overexpressed in many cancer cells. Hydrophobic DOX and hydrophilic MSA-capped QD were encapsulated in the bilayer and core of the PEG-PLGA nanopolymersomes, respectively. Our data show that the formulated NPs sustained DOX release for a period of 12 days. Fluorescence microscopy and MTT assay demonstrated that the developed folate-targeted DOX-QD NPs had higher cytotoxicity than non-targeted NPs and the free form of the drug; moreover, they preferentially accumulated in 4T1 and MCF-7 cells in vitro. In vivo experiments including whole organ tissue–homogenate analysis and organ fluorescence microscopy imaging of BALB/c mice bearing 4T1 breast adenocarcinoma showed that the folate receptor–targeted QD encapsulated NPs accumulate at tumor sites 6 h following intravenous injection. Acute toxicity studies of the prepared targeted QD-loaded NPs showed no evidence of long-term harmful histopathological and physiological effects on the treated animals. The in vivo tumor inhibitory effect of folic acid (FA)-QD-DOX NPs demonstrated an augmented therapeutic efficacy of targeted formulation over the non-targeted and free drug. The data obtained illustrate a high potential of the prepared targeted theranostic nanoplatform in the treatment and imaging of breast cancer. This study may open new directions for preparation of QD-based theranostic polymersomes for clinical application.

Reflections

ANC2016 which was held in Austria is the most important experience in my professional life as I gained the opportunity to meet clever, young and active researcher in the field of nanotechnology from other countries, talk to them, and listen about their research. In this regard, we made a scientific and friendship network to be connected in the future and maybe we can have the opportunity to work on a joint project.

It was very nice trip since site visits of Wien University, their facilities and also visits of historical places such as schonbrun castle were so enjoyable. On the other hand, the great hospitality of Dr. Andre Gaszo and also talking to Dr. Lewren was so pleasant and memorable for me then many thanks to them. The technical lectures in various area of nanotechnology by participants and experts were very crucial for my future nano-projects.

ANC provided the very useful information in the field of risk assessments of new technologies and sustainability. These are the subjects that I never think about them before. This event made me rethink about the outcome of my research positively and also negatively. Now I'm rethinking about the byproducts, environmental toxicities and benefits and/or drawbacks of my research in the human's lives and also in the community and public health. At the end, while nanotechnology provides us with great benefits, development of sustainable nanotechnology is essential to ensure that the developments of today do not adversely affect our future.

Japan

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Keywords: Nanomechanical sensors, artificial olfactory system, signal processing, finite element analysis (FEA), graphene

Research Interests:

I received my PhD in 2013 from the University of Tokyo, where I was working on graphene, particularly on the synthesis of nitrogen doped graphene. From 2013 to 2014, I worked as a post-doctoral researcher at the University of Tokyo. I focused on the transport properties of nitrogen doped graphene. In 2015, I moved to the National Institute for Materials Science (NIMS) as a post-doctoral researcher to work on nanomechanical sensors.

My research interests lie in the field of chemical sensors, particularly in nanomechanical sensors. I have developed receptor materials which yield high sensitivity and high specificity. I am also interested in developing an analysis method for sensor signals. By utilizing a membrane type surface stress sensor (MSS), a newly developed nanomechanical sensor in 2011, I aim to develop an artificial olfactory system.

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Abstract of Presentation:

Artificial olfactory systems are attracting much attention because they can be applied to various fields such as environments, foods, safety, healthcare, and so on. Due to its high sensitivity and versatility, a nanomechanical sensor is expected to be an optimal candidate for the artificial olfaction. However, not only sensors with high sensitivity but also analytical methods for sensor signals are required to recognize odors. In this study I propose a signal analysis method which enables one to distinguish odors (gas molecules). I have successfully developed an analytical model which agrees with experimentally obtained sensor signals, and from this one can extract parameters which can be used to distinguish between gas molecules. By using a multichannel membrane type surface stress sensor (MSS), a newly developed nanomechanical sensor, more accurate recognition of odors can be achieved.

Reflections

I joined the ANC2016, which was held in Austria from 3 to 7 April. On the second day in Vienna, we visited Austrian Institute of Technology (AIT) and met Dr. Heer, who studies nano-biosensors. His talk and the site visit were very interesting for me because I also study on sensors and attempt to apply the sensors to medical use. Their studies mainly focused on saliva analysis while my research focuses on exhaled breath analysis, both of which are great candidates for non-invasive diagnostics. After visiting the AIT, we visited the Vienna University of Technology, in which we made a lab-tour. On the third day, we visited IMC Krems and joined the workshop "Safe and sustainable development of nanotechnology", in which we gave presentations and had debates. On the fourth day, we attended lectures focusing on safety & risks and sustainability issues in nanotechnology. Among the lectures, I was impressed by Prof. Songsivilai's talk. He showed us what the sustainable development is and what actions should be taken for that. He also showed us the framework for the sustainable development of nanotechnology in Thailand and national strategic plan for the nanotechnology. Ms. Kuhn's talk on the Austrian national actions on nanotechnology was also interesting because I could overview the difference in the framework between Thailand (Asia) and Austria (Europe). On the last two days we attended BioNanoMed2016. As I work on sensors (especially on nanomechanical sensors), presentations on sensing and imaging techniques were very interesting.

I debated "Sustainability Driven Innovation (Technology vs Individual)" as a member of group C. Innovation solves an existing problem but a new problem appears associated with the innovation. Thus we as scientists need to continuously make innovations for the sustainable development. Not only solving existing problems but also creating new values and new life-styles is an important aspect of innovations. Continuous innovations and creation of new values are our conclusion for the role of innovation from the view point of technology. After the debate, we recognized that both technology and individual should think about and contribute to the innovation. Technology always makes human's life convenient and efficient, but sometimes people lose skills and instincts. For the sustainable development, innovations shall be conducted considering both technology and humanity.
I have to think about this when I conduct my research: development of a sensor system toward artificial olfaction. If an artificial olfactory system is achieved, it will create new values and change our lives. However, it also has risks on disrupting traditional industries and degradation of human's ability.

It was a great opportunity for me to discuss "safe and sustainable development of nanotechnology", which I had never carefully thought about. As Dr. Liu told us, we have to have a broad picture of research. We have to think about our research from many different angles; consider effects and consequences of our research, position ourselves in the community, society, and world. Not only the site visits and lectures but also talking with the participants and students in Krems was inspiring. I would like to acknowledge the organizers for providing me with such wonderful days in Austria.

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Keywords: Condensed matter physics, electronic structure theory, first-principles methods based on the density functional theory (DFT), molecular solids, ferroelectrics, organic photovoltaics.

Research Interests:

My research mission is the understanding exiting physical phenomena in various molecular solids by first-principles electronic structure calculation methods based on the density functional theory (DFT). By applying physical or chemical pressure (chemical adjustments) for molecular crystals, amazingly, a wide variety of phase transitions appears. The observed phase phenomena include superconductors, frustrated magnets, charge ordering, ferroelectricity, and so on. These phenomena are originated from their strong electron-electron interactions and soft-lattice. In my research, we will clarify the microscopic mechanisms of such emergent properties and design new functional materials in collaboration with experimentalists.

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Abstract of Presentation:

Dirac cone is an unusual electronic state showing linear dispersion relations when the top of the occupied bands contacts with the bottom of the unoccupied bands in a point at the Fermi level. The existence of Dirac points at the Fermi level is responsible for many important properties of the materials such as high electron mobility that originates from the fact that effective electron mass is zero. Most molecular crystals composed of a single-component molecule show usually insulating property at ambient pressure. By applying pressure, some of them turn to be a conducting (or superconducting) state. By performing structural optimization on the basis of the first-principles calculations, we found Dirac cones in a single-component molecular crystal, Pd(dddt)2, under the pressure of 8 GPa. Our analysis of the electronic structure shows that the intermolecular hybridization between the HOMO and the LUMO of neighbouring molecules increases by the pressure. We found that such multi-orbital nature is closely related to the mechanism of the Dirac corn formation. Simple explanation on the Dirac corn formation will be presented.

Reflections

Though the ANC and Bionanomed conference, I learned that nanoparticles of transition metal oxides are very useful for biomedical applications. Their solid-state properties are well studied in condensed matter physics (such as ferrite/magnetite). Therefore, we could find something new properties by realizing "nano"particles in the collaboration with the structural and magnetic characterization studies of the particles.

In our pre-meeting of the debate, we discussed what could we do as a consumer? Even though there are international rules, we need to consider before we buy something in store each person has policy for consuming.Responsibility for consumption is following issues.

1) Pay attention what we you buy: wrapping, way of growing of fish/animals, quality of products…
2) Should have responsibility for the wrapping and plastic bags from stores. It is better to bring own bag. Education: We should know how the recycling works? If parents do not know that, we could not educate kids. I thought if the technologies are very developed, we should not forget what we can do as a human, and what I lost by the new technologies.

Nowadays, when we know something we can ask to google, but though the discussion and debates of the workshop, I realized that we can made new statements or ideas by the discussions for technological safety issues These are not seen in the any website. I also note that I learned different way of discussion by Austrian students and researchers from other Asian countries. I inspired by the discussions with them.

Korea

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Keywords: Nanobio sensor, Electrochemical analysis, Botulinum neurotoxin, Chemical lithography, Nanoparticle synthesis

Research Interests:
Our group is interested in the development of the sensor for the detection of bio materials such as bacterial, virus, and protein. I have been working on the label-free electrochemical detection of *Botulinum* neurotoxin (*Bo*NT) by using the micro/nano-gap device. We detect *Bo*NT through the redox signal change of ferri-ferrocyanide caused by the activity of *Bo*NT. It was able to detect the *Bo*NT type E light chain whose concentration was as low as the lethal dose. I am supposed to observe the kinetic mechanism of *Bo*NT via this method.

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Abstract of presentation
We developed a simple label-free electrochemical sensor for the detection of Botulinum neurotoxin type E light chain (BoNT/E LC). BoNT is one of the most poisonous toxins and trace amounts of BoNT can cause the botulism with the high fatality. In this study, the dual mode cyclic voltammetry was used to observe the cycling redox signal of ferri-ferrocyanide, which was interrupted by peptides immobilized on interdigitated micro-gap electrodes and increased after the introduction of BoNT/E LC due to the enzymatical cleavage reaction. The peptides were designed from synaptosomal-associated protein 25 to be cleaved by BoNT/E LC. BoNT/E LC of as low as 5 pg/ml was readily detectable with this method and the detection limit is expected to be improved upon reduction of the gap distance to the nanometer regime.

Reflections
(1)Austrian Institute of Technology, Institute of Molecular Diagnositics
SALIVA diagnositics, biomarker discovery & validation, bioinformatics, assay development & validation, diagnostic biosensors, systems integration & point of care devices, micro & nano technology
We were introduced about the molecular diagnostics research what is going on in AIT and their facility. It is similar with researches of our group such as the bio-molecule detection using the device and using the magnetic particles. I surprised by their ideas and result and it is an inspiration to me.
(2) Technical University of Vienna
Computational Science and Engineering, Quantum Physics and Quantum Technologies, Materials and Matter, Information and Communication, Technology and Energy + Environment
I entered the clean room in other country for the first time and I was impressed with complex and sophisticated facility. In case of the photolithography equipment, it is familiar for me.
(3)Danube University Krems and IMC Krems
We visited to the laboratory of IMC Krems and it was similar to my laboratory. Good facilities were impressive.
(4) European perspectives and Asian approaches to nanosafety- OEAW/NIK Workshop within ANC 2016 Krems
I was informed about the Austria's management for the safety and I knew the effort of EU and Asia for Nanosafety.
(5)BioNanoMed 2016, Nanotechnology for Detection, Diagnosis, Imaging & Sensing I
Talks in this session were very interesting. I'm working on the nanobiosensor, so these talks very helped to me. It was a good chance to know about the trend of this field and I got a hint to overcome the problems in my research.

I investigated the nanotechnology implication; risk. Among the various risk of nanotechnology, I searched for the nanotech weapons. Nowadays, I'm developing the nanobio sensors for the detection of Botulinum neurotoxin. I already heard it is possible Botulinum neurotoxin is used as weapons for the bioterrorism. So, I prepared that the potential risk of nanotech weapon and I learned a lot about it. Actually, this risk have brought me a fear.

It was a really great experience for me. I'm very glad to know good people. Actually, I didn't have a chance to talk with people of other countries about the research in nanotechnology. I had a conversation with people from other countries through this time. ANC 2016 served as a momentum to awaken importance of nanosafety to me. I always think how I improve the performance of sensor. I have never considered about the risk of nanotechnology. I realized that the thinking about the risk and safety must be put first.

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Keywords: Organic-inorganic hybrid perovskite, resistive switching, nonvolatile memory, RRAM(Resistive random access memory)

Research Interests:
My research is focused on the resistive switching behaviour in ZnO and organic-inorganic hybrid perovskite. Primarily I have been studying not only the resistive switching behaviour in ZnO with thin film, nanowire, and compact nanorod structure but also the improvement method for RRAM device performance.

Especially, the organic-inorganic hybrid perovskite material is one of the attractive materials in the memory device applications due to its various functionalities and simple fabrication process. Nevertheless, most of the former studies have been focused on the ABO_3 ternary type inorganic oxide perovskite materials. I began to study the possibility of application to RRAM device, furthermore, we reported the first demonstration of the resistive switching behavior in organic-inorganic hybrid perovskite.

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Abstract of presentation
The organic-inorganic hybrid perovskite materials open a new era for developing low-cost and high performance solar cells due to its simple and inexpensive fabrication process, superior optical and electronic properties, and excellent flexibility in material design. The application fields have been expanded to electronic devices as well as other optical devices. One of the potential applications is a resistive switching memory device where the organic-inorganic hybrid perovskite material is used as a switching layer. Herein, we demonstrate the remarkable resistive switching behaviour of organic-inorganic hybrid perovskite materials (CH3NH3PbI3-xClx), which can be applicable to the memory devices. The organic-inorganic hybrid perovskite material can be readily fabricated by a low-temperature solution-processable method with high crystallinity. The designed Au/CH3NH3PbI3-xClx /FTO structure shows impressive resistive switching behaviour with stable endurance over 100 times and long retention of 104swith low on-off voltage of < 1 V. These results signify that the CH3NH3PbI3-xClx perovskite material meets successfully the criteria of a switching layer for non-volatile memory devices with competent RS behaviour accompanying low operating voltage and high stability.

Reflections
First of all, I would like to thank ANC 2016 organizers for a great and instructive times in Austria.
The presentation and site visits under the workshop topic, "Safe and Sustainable Development of Nanotechnologies & Responsible Innovation towards Sustainability", was very interesting. Actually, I have never thought about these issues very carefully, although the safe and sustainable development of nanotechnologies is extremely important. The presentation and debate program of ANC 2016 gave me an opportunity to think not only about my responsibility but also the pointing spot of my future research that contains these issues. First, from site visits, I felt that Austria has an excellent infrastructure to develop nanotechnology and many researchers are passionate about their research. Furthermore, I spent a lot of interesting time with ANC 2016 participants discussing the various research field based on the nanotechnology by which I was extremely impressed. All of them, they were very serious but humorous at sometimes. Particularly, in this camp, I will not be able to forget the debate session.
I have been a member of the "Me" team of Sustainability driven innovation topic in debate. Because it was so hard to find the appropriate answer, this topic got me thinking in many ways and I am still considering that How I can contribute to the sustainability driven innovation. I strongly agree that the technology can make a better future as well. However, we first should consider the definition of "sustainability". The important thing is that the sustainability science is the study of sustainable development and environmental science. It is clearly obvious that the development of technology is for human. However, I cannot answer well that "What is the development of technology for?". It can be one of examples that many people suffer due to the environmental destruction like global warming and we have spent a lot of time to solve this problem where its vicious circle doesn't really mean anything literally. I believe that it can be just controlled or stopped by human like myself. As a result, we can play a more important role for "sustainability driven innovation" than that of technology. We know about that already. With this camp as a momentum, I hope not just to talk the talk, but to walk the walk for the sustainable development of Nanotechnology. In conclusion, it was very significant time at ANC 2016. I would like to thank all participants for your kindness and wish you all the best.

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Nanobiotechnology, University of Science and Technology (UST)
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Keywords: Magnetic nanoparticle, Surface Plasmon Resonance (SPR), Bionano Sensor, Photocatalyst, Nanomaterial

Research Interests:

Super bacteria or viruses are threatening our society. Outbreaks of infectious disease result in economic losses totalling several billions of dollars annually

Therefore, early detection of these harmful pathogens is very important. I'm interested in nano plasmonic sensor for detection tool such as SPR (Surface Plasmon Resonance) using magnetic nano particle or photocatalyst.

Surface Plasmon Resonance (SPR) is an optical detection process that occurs when a polarized light hits a prism covered by a thin (gold) metal layer. Under certain conditions (wavelength, polarization and incidence angle) free electrons at the surface of the biochip absorb incident light photons and convert them into surface plasmon waves. A dip in reflectivity of the light is seen under these SPR conditions.

For detection some molecules, certain linker like antibody is required. I focus on linker and report a novel phage endolysin cell wall-binding domain (CBD) for B. cereus and the development of a highly specific and sensitive surface plasmon resonance (SPR)-based B. cereus detection method using the CBD. The newly discovered CBD from endolysin of PBC1, a B. cereus-specific bacteriophage, provides high specificity and binding capacity to B. cereus. By using the CBD-modified SPR chips, B. cereus can be detected at low concentration.

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Abstract of Presentation:

Rapid, specific and sensitive detection of pathogenic bacteria is crucial for public health and safety. Bacillus cereus is harmful as it causes foodborne illness and a number of systemic and local infections. We report a novel phage endolysin cell wall-binding domain (CBD) for B. cereus and the development of a highly specific and sensitive surface plasmon resonance (SPR)-based B. cereus detection method using the CBD. The newly discovered CBD from endolysin of PBC1, a B. cereus-specific bacteriophage, provides high specificity and binding capacity to B. cereus. By using the CBD-modified SPR chips, B. cereus can be detected at the range of 105–108 CFU/ml. More importantly, the detection limit can be improved to 102 CFU/ml by using a subtractive inhibition assay based on the pre-incubation of B. cereus and CBDs, removal of CBD-bound B. cereus, and SPR detection of the unbound CBDs. The present study suggests that the small and genetically engineered CBDs can be promising biological probes for B. cereus. We anticipate that the CBD based SPR-sensing methods will be useful for the sensitive, selective, and rapid detection of B. cereus

Reflections.

In Austria, we visited department of molecular diagnostics, AIT (Austrian Institute of Technology), in Vienna. The institute is focused on developing diagnostic biosensor system concepts for POC(Poin-Of-Care), delivering solutions that perfectly meet customers' application needs. In Technical University of Vienna, I also had a lecture and had a laboratory tour. IMC (university) which is located in the city, Krems Krems on the Danube is famous for its architecture, culture and art. Historic buildings in the town, which were indicated in the year 2000 as an UNESCO World heritage. I can enjoy the different faces of the city, if I go through the old city, surrounded by shops, restaurants and coffee houses. In IMC Krems, many young students are interested in nanotechnology and I can feel the enthusiasm in learning. Furthermore I can have an experience about the university in another country and have a laboratory tour. But the true thing is that learning is same all over the world.

As a Ph.D candidate in nanotechnology, I have thought about the phenomenon or just technology itself. For example, when I studied in my research field, I just thought about the experiment and the results. I had little chances to consider the residual products from the experiment such as nanoparticles which will maybe influence the planet. Where do the wastes of research go? I haven't thought about it ever however I had a great opportunity to think about it and the future of nanotechnology in addition to sustainability which I used to overlook.Technologies have been developing remarkably from day to day and we human beings are reaping benefits at the same time. However, is this all? We win some, we lose some. If we run straight just looking ahead, we will be confronted with unavoidable problems soon. There is a circulation between technology and our life. If human beings need innovation, the technology makes innovation. If the innovation made, another needs are occurred. Let's have an example.There are so many cars in the world, at the same time the trash is made enormously. Technology can use the trash for making another useful product and develop some novel eco-friendly materials which are degraded. In terms of nanotechnology, making novel material which can be recycled and reused is possible. But….sustainability is more than recycling or reusing it is a whole system view of life on our planet and how people and companies participate in that life. Sustainability ensures a better quality of life, now and for generation to come.Technologies make the quality of human being more convenient so technology can remain our society. However if we pursue just these benefits, we might lose bigger things someday. So, the most important thing is nanotechnology more."HUMANITY" is something we must keep in mind. There are many benefits and losses by nanotechnology, so if we would like to maintain our world we must think both aspects, Technology and Individual at once. We must not forget the "HUMANITY".

From ANC2016, I met many people, scientists all over the Asia and Austria and had a good relationship with them. I can feel the heart of HUMANITY which is the best important in technology. It was a wonderful opportunity to expand my idea about Nanotechnology and the society. I would like to thank the organizers and the party concerned.

Malaysia

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Keywords: nanomaterial, metal oxide, sensor, graphene, environmental

Research Interests:
I have been awarded Msc and PhD degree in mechanical system from University Science of Malaysia. My research interests include modelling and simulation of MEMS/NEMS devices, nanomaterials characterisations and nanosensors development. At present, my focusing is on graphene-based research activities.

References:
[1] Khairul Anuar Abd Wahid, Wai Yee Lee, Hing Wah Lee, Aun Shih Teh, Daniel C.S. Bien and Ishak Abd Azid, Effect of seed annealing temperature and growth duration on hydrothermal ZnO nanorod structures and their electrical characteristics, Applied Surface Science, 283 (2013) 629-635, Science Direct.
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Abstract of Presentation:
A high sensitivity and accurate gas sensor with operating temperature at room temperature has been successfully developed by using ZnO nanorods. The ZnO nanorods were grown on interdigitated electrodes (IDEs) at different growth time lengths at 3, 6 and 9 hours. It has been ascertained that the length and diameter of ZnO nanorods increased with increasing growth time with aspect ratio of 11, 16 and 15 for growth time of 3, 6 and 9 hours respectively. It has been observed that the electrical characteristics of the ZnO nanorods are also affected in which the electrical resistivity and sheet resistance increases proportionally with the growth duration. The sensitivity of grown ZnO nanorods with oxygen gas from 20% to 24% shown that ZnO nanorods grown at 3 hours give highest sensitivities with ΔRgas is 58% followed with 6 and 9 hours growth duration. It was also found that electrical resistivity also play an important role where the low electrical resistivity is preferred for high sensitivity oxygen gas sensor. The sensor shows a good response and recovery time as the oxygen is varied from 20% to 25%. The grown ZnO nanorods also has better selectivity with oxygen up to 5 times higher compared to other indoor ambience parameters indicated that the sensor has a potential to be applied as indoor oxygen gas sensor at room temperature operation. The sensor drift due to fluctuation of temperature, humidity and ageing time in real environment has successfully been compensated via baseline manipulation method and the results show the 99.5% accuracy compared to commercial sensor.

Reflections
Technical site visits at Vienna Technical Institutes and lectures at Krems University was exposed me to the most advance current research works related to Biomedical application. Most of the currents research works move to applied research which means used the nanomaterials as a basis for development of biosensors for diagnostics point of care testing. Among the details of presented projects, research works on development of printable biosensors catch my attention as we in MIMOS currently also working on printable electrode technologies. Printable sensors becoming a research trend in recent study as it more compatible to human body rather than a rigid semiconductor based devices. As in Vienna Technical Institutes focus on functionalization of sensor devices by using commercial conductive inks, we're in MIMOS has a bigger plan in this technology in which we're tend to setup our own printable electrodes technology for mass manufacturing level. At the moment, we successfully synthesized conductive inks by using silver-graphene based. The electrical properties have been analyzed and the conductivity is comparable with commercial silver inks. Few types of electrodes have been successfully printed on PET films such as interdigitated electrodes, 3-electrodes system for electrochemical application and micro-heater. However, our printable electrodes technology currently is limited by 300µ size. More research works need to be done to improvise the outcome. It's really good to knows that we're not alone in this research technology as printable electrodes on flexible substrates forecasted will be highly demand in the near future for flexible electronics devices. We're really hopes to collaborate with the right team in order to expedite the maturity of this technology.

Risks and safety issues are the most important theme regularly emphasized in our works cultures (MIMOS BHD). However, ANC 2016 successfully brings this theme at another higher level where it triggered me in self-awareness for future global concern in view of humanity perspective rather than just obey the risks and safety guide just because its company rules. Beyond that, it also triggers the self-responsibility in me to create a truly near green technology including synthesis process, waste management as well as product applications. My contribution for next research in nanotechnology will mainly focused on green synthesis technology for nanomaterials and to highlights the risks, safety and sustainability issues of nanotechnology in every weekly meeting as well as during project updates. I'll try my best to create this issue to become typical topic discussion among group members so that we all share the equal responsibility.

I truly hope the connection among the ANC 2016 participants does not stop here but growth bigger so that the important issues such this keep remain in our minds. Regarding this, more constructive messages need to be delivered not only to among the scientist but at higher level such as government. To execute this, more ideas and data from the participants is needed by collectively. ANF secretariat may need take a lead to coordinate this long term activities.

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Keywords: polymer nanofibers, nanoparticles, electrospinning, scaffolds, regeneration of skin tissues

Research Interests:
Research interests: 1). Fabrication of polymer nanofibers by electrospinning. 2.) Synthesis of nanoparticles utilizing fruit and plant extracts.
Research experience: 1). Synthesis of selenium nanoparticles (SeNP) using ascorbic acid. 2.) Synthesis of silver nanoparticles (AgNP) using seaweed / algae extract. 3). Purification and functionalization for oxidized of multi-walled carbon nanotubes (MWCNT). 4). Fabrication of

biodegradable polymer nanofibers with incorporation of nanoparticles (MWCNT and AgNPs) by electrospinning.

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[3] Alias Mohd Yusof, Abdull Rahim Mohd Yusoff, Noor Aini Abdul Rashid, Shafinaz Shahir and Nurul Asyikin Kamaruzaman. Synthesis and Characterization of Selenium Nanoparticles Induced by Ultrasonication Irridiation with Ascorbic Acid as Reducing Agents. Faculty Science Post-Graduate Conference (FSPGS) 2010, UTM Skudai, Johor, 2010. ISBN: 978-983-9805-93-2.

Abstract of Presentation:

Tissue engineering is critical nowadays mainly in plastic surgery and skin injuries from burns, accidents, disease, chronic wounds, acute trauma and diabetic ulcers and venous. Tissue transplantation is a common treatment method used for treatment. Nevertheless, it is very limited due to lack of donors. Other alternative treatments such as surgical reconstruction, drug therapy, synthetic prostheses and medical devices are available but it cannot replace and regenerate all the functions of the damaged or loss tissue. Hence, skin substitutes were considered as new treatment by most medical practitioners for wound dressing and healing. Currently, the fabrication of polymer nanofiber scaffolds were used as materials in wound dressing and healing. Incorporation of polycaprolactone (PCL) with multi-walled carbon nanotubes (MWCNT) and silver nanoparticles (AgNP) in the nanofibers has yield a promising results such as higher hydrophobic properties and possess a better desirable mechanical property as compared to PCL itself. Antimicrobial activity in the AgNP can hinder burns and open wounds infection when added in the polymer nanofiber scaffolds. While, MWCNT can enhanced mechanical properties of nanofibers. Lastly, fabrication of polymer nanofiber scaffolds with characteristics such as safe, antibacterial, anti-inflammation, biodegradable and has high biocompatibility is one of the materials for skin tissue regeneration in wound dressing and healing.

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Keywords: nanotechnology, nanocomposite, polymer, graphene

Research Interests:

My research basically deals with nanotechnology. Previously, I have been working on nanocellulose from agricultural biomass incorporated with polymer via in situ polymerization method to produce nanocomposite. Additionally, my research interest is on the polymer processing and green biochemical-biotechnology which includes the synthesis of polylactic from kenaf biomass. Since my expertise is in materials engineering (a kind of broad area of study), currently I am working on the creation of nanographene as the potential materials in industry. It covers 5 areas such as plastics, rubber, nanolubricant, Lithium ion battery, and ultracapacitors.

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Abstract of Presentation:

In view of the environmental awareness, safety and sustainable issue, continuous demand on biodegradable materials are steadily increasing, a diverse range of emerging nanotechnologies promise to secure modern solutions to conventional one. However, in terms of commercialization, biodegradable materials still need distinct approaches capitalizes on different principles, concepts and methodologies to address different application requirements, but their common objective is to open a window to a safety and sustainable future. In this camp, the introduction of graphene as a filler in biodegradable materials had been discussed. The incorporation of such graphene with existing biopolymers to become a composite show great promise for the development of a new generation of advanced materials. Graphene is a “wonder” materials that had vast potential applications in industry specifically in composite industry. It is found that if the graphene is in nanosize then only small loading percentage of it will be used in the composite industry. Thus, the safety issue for that will be at minimum risk. However it is fundamental to examine the toxicity of the product towards commercialization. Indeed, an integrated approach to research, cooperation and communication strategies are essential towards responsible and sustainable growth of nanotechnologies.

Reflections

4th April 2016: The first site visit was at Austrian Institute of Technology, Institute of Molecular Diagnostic, Vienna (AIT). In this institute, their research on the development of highly sensitive diagnostic biosensors and miniaturized systems for molecular point-of care diagnostics was introduced. AIT has strong expertise in the integration of biomarkers, sensors, microfluidics, reactors, thermal management and readout electronics for such system. They are well equipped with micro and nanotechnology lab which include fabrication which specializes in heterogeneous integration and precision assembly of different materials and components, characterization, simulation and modelling. They are well equipped with clean room, material printer, probe station and simulation

cluster. The second site visit was at Technical University of Vienna (TU Wien). Basically, TU Wien provided a support on research and development in microelectronics, photonics, and sensor technology. They also facilitate the education and training to the graduates transfer state of the art know how to industry. TU Wien introduced their laboratories and clean room which related to the research on microelectronics, nanoelectronics, photonics, and microsystems. They had done a research on graphene-based optoelectronics, advanced lithography, piezoelectric thin film and more. 5th April 2016: Dr Andre Gazco and Dr Lerwen Liu presented on the introduction to workshop topic safe and sustainable development of Nanotechnologies and responsible innovation towards sustainability. Then, participants presented their topics. Most of them are research officer and doing research of microelectronics systems. There were also presented research on biomedical, gas sensor and memory sensing. Most of them relates their research with the safety and sustainability issue which is the main theme for ANC 2016. Later then, the participants had a debate on Nanotechnology Application and Implication; sustainability Driven Innovation- Technology and Me. 6th April 2016: Dr Andre Gazco presented on the topic Nanosafety and concepts of Nanorisk Governance. From his presentation, the meaning of risk was clearly defined. The safety of the nanotechnology had been discussed based on its fundamental principles of good governance and precautionary approach to new technologies under European Commision published Action Plan on Nanotechnology in 2004. There are three pillars of safe and responsible development of nanotechnologies were presented which were establishing an independent safety research process, developing a transparent communication strategy for the public and setting up international networks to foster both. Next, Prof Sirirugrg form NANOTEC, Thailand presented on the role of safety and trust in promoting global benefits of responsible nanotechnologies specifically on Thailand's perpective. In his presentation, he presented on public acceptance on the emerging technologies with and without good governance and safety management which is very crucial issue. In order to facilitate sustainable utilization of nanotechnology, public understanding and trust especially on the safety, benefits and limitations of nanotechnology should therefore be integrated in all stage of the development and product release. Thus, National Nanotechnology Center, NANOTEC, National Nanotechnology Development Agency (NSTDA) in Thailand had taken the role for the issue of nanosafety and risk management of nanotechnology. Next, is the presentation by Dr Antonia Praetorius on the detection of engineered nanoparticles in water, soil and sediments from bulk analysis to single particle ICP-TOF-MS that summarised on the challenging aspect of detection of engineered NPs in complex natural media and the comparatively high background of natural particles. Next, Prof Marion Huber Humer presented the nanomaterials in the environment- the role of waste management. To summarized, basically she presented that the amount of consumer products containing nanotechnology enabled engineered materials is steadily increasing and the potential release pathways of nanowaste and end of life nanoproducts predominantly depend on the country specific waste management systems. Next, the topic on nanocrystal from synthesis to applications as tracer materials was presented by Mr DiFlorian. The topic was quite similar to Dr Antonia but the different is he introduced on some case study on concept of nanotracing in order to distinctively monitor their long term behaviour in complex environmental matrices. After that, Dr Alexandra and Mag Lisa presented on innovation and safety in Austria and Nanosafety within the context of EU legislation on consumer protection respectively. Basically, they introduced that Austria's federal government has provided a clear mandate for the implementation of several funding activities concerning nanotechnology safety.Last but not least, Dr Lerwen was presented on the topic of developing the responsible mind set in nanotechnology enabled innovation toward sustainability. In her presentation, she stress on the responsible innovation mind set in science and technology highlighted on the application and implication of nanotechnology towards sustainability. After finished all the presentation, the site visit at the University of Applied Science, Krems's laboratories was conducted. Basically this university focused on medical biotechnology research. 7-8th April 2016: Had attended several talks such as a bifunctional nanoprobe based to disclose the happy face and sad face of cells, biomedical diagnostics based on optical observation of the rotational dynamics of hybrid nanoparticles, One-step mixing with humanied bisoecific antibodies enhances tumor targeting and therapeutic efficacy of mPEGlated nanoparticles etc. Basically, the talks that I attended is more on 3D technologies for nanomedicine and Nano Oncology Drug delivery and therapeutics. There are two talks related to graphene in the implication for non-toxic cancer treatment.

Indeed, there are many application and implication of nanotechnology which involved the broad area of medical, environment, energy as well as economic upheaval. There are also many benefits and negative of technology vs individual. In order to make those balance, the awareness on such topic should be introduced to the public and some proper risk and safety managements should be conducted. The conservation and promotion of nanotechnology, adoption of relevant nanotechnology production method which include the proper waste and energy management and education for better nanotechnology utilization in industry should be done. Additionally, by doing all those act, the nanotechnology can be sustained in clean, safety and fair matters, environmentally, economically, and socio-culturally.

From ANC 2016, I am aware on the safety and risk of nanotechnology issue that should be taken into consideration. I was inspired by several presentations by the invited speakers and participants of ANC 2016 as well as Bionanomed 2016. Even though it is not really related to my educational background but it gave me some knowledge that there are many research had been done in nanotechnology especially on graphene that may be useful for my work as way to approach more companies on the research of graphene.

Singapore

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Keywords: anodic aluminium oxide, atomic layer deposition, TiO2, MoS2, photoluminescence

Research Interests

I graduated from National University of Singapore (NUS) with a PhD in Chemistry. I am currently a senior specialist in IMRE. My research interests are focus on nanofabrication, particularly template nanoporous structures such as anodic aluminium oxide (AAO) and thin film deposition technique such as atomic layer

deposition (ALD) technique. I am working on the development of ALD as a nanofabrication tool in the preparation of nanomaterials, including 1D TiO2 nanotubes arrays (NTAs), 2D MoS2 nanofilms, and also their potential applications.

References:

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Abstract of presentation

ALD process is a thin film deposition technique developed and widely used in the microelectronics industry. The attractiveness of the ALD process is owing to its ability to facilitate precise film thickness control and conformal film deposition. We established a "template-assisted ALD" approach, which consists of depositing ALD of TiO2 films into the pores of anodic aluminium oxide (AAO) templates. By means of this approach, transparent and well-aligned 1D TiO2 nanotube arrays (NTAs) on glass substrates functionalized with Pd nanoparticles, acts as UV light-activated photocatalysts. The conformality of the ALD process in different dimensions and morphologies of the PAA templates, results TiO2 NTAs also having different dimensions and morphologies after the templates removal. A novel ALD process can also grow 2D materials such as MoS2 nanofilms on sapphire substrates. As the ALD process can precisely control the MoS2 film thickness by means of selecting the number of deposition cycles, monolayers of MoS2 films exhibiting photoluminescence emission in the visible range can be prepared by this process. In summary, 1D TiO2 NTAs were successfully prepared using the template-assisted ALD approach and 2D MoS2 nanofilms were prepared, using a novel ALD process. ALD is the method of choice for the nanofabrication process.

Reflections

04 April 2016 - Austrian Institute of Technology (AIT), Institute of Molecular Diagnostics: The main focus of AIT is in diagnostic biosensor development, divided into photonic biosensors, magnetic biosensors and electrical/electrochemical sensors. 04 April 2016 - Technical University of Vienna (TU Wien): We visited the cleanroom where there are many micro and nano-fabrication and characterization equipment/tools such as lithography, MBE, CVD, ALD, etching, SEM, XRD, microscopy etc. No photography allowed in the cleanroom. 04 April 2016 – Vienna Schönbrunn Palace: Guided tour trip into residence of the Habsburg emperors, focusing mainly on Emperor Franz Joseph and his family. No photography allowed inside the palace. 05 April 2016 – ANC 2016 Workshop, IMC Krems: The main highlight and most enriching talk was by Dr Liu where she shared with us the responsible innovation value chain, using smart phone as a model. During the workshop, all participants presented their research works and also most importantly, they discussed how they can contribute to a safe and sustainable development in their work. The debate follows thereafter where 4 teams presented and debate on their respective topics. 06 April 2016 – ANC 2016 Workshop & IMC Krems site visit: Talks by invited speakers on nanosafety and nanorisks. Visit to IMC Krems laboratories from biological, chemistry and microscopy labs. 07 April 2016 – BioNanomed conference: The topics covered are multidiscipline, ranging from materials, diagnostics, imaging and sensing to drug delivery, pharmaceuticals and regenerative nanomedicine. I found a few posters on nanotoxicology of TiO2 nanoparticles and Ag nanoparticles.

It never occurred to me about the nanotoxicity and sustainability issues on my research work. I am a chemist by training and conscious of all the handling and disposal of toxic and hazardous chemicals. However, material in its nano form has a different behaviour from its bulk form, in terms of properties and also toxicity. I would think that if it is safe in its bulk form and how "dangerous" it can be on both human and environment in its smallest dimension? The responsible innovation value chain puts me to think about my entire research process in a broader scale. It is beyond achieving the greatest performance for my nanomaterials or devices. I have the "one-way" mindset that the advances in nanotechnology is for the benefits of mankind. Fortunately, the workshop and debate enlighten me that there pros and cons in nanotechnology development. Nobody mentioned or questioned sustainability issues related to my research work. The focus is always on costs, fundings, collaborations and applications. Currently, there are not many comprehensive research and also support on nanosafety and sustainability issues from both the research community and government. These issues are lacking behind the advances of nanotechnology development, in terms of awareness and also support. It is also dishearten to hear from one of the invited speakers from Europe that their institute also has weak support on nanosafety and sustainability issues.

I am extremely grateful that I have the opportunity to attend the 9th Asia Nanotech Camp. It gives me a broader perspective on my and also on others' research work, not technically but on the safety and sustainability impact it could lead to, for our future generations.

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Keywords: self-assembly nanofabrication, nanoimprinting, plasmonics, SERS, block copolymer

Research Interests:

My research interest is in the area of fabrication of micro and nanostructures using both bottom up self-assembly fabrication techniques, e.g. block copolymers, nanospheres, DNAs and top down patterning like nanoimprinting. I am interested in engineering nanoscale properties like plasmonics, electronics, and surface functional properties. My aim is to develop low cost and scalable fabrication processes so that these nanostructures can be adopted in real world applications. Some of the applications that I am working on include surface enhanced Raman spectroscopy (SERS) and plasmonic enhanced infrared sensing.

References:

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Abstract of Presentation:
Surface enhanced Raman scattering (SERS) is an analytical technique that offers the capability of remote sensing, single molecule detection, and detection of trace contaminants (in parts per million) with high sensitivity and accuracy. Here, we demonstrate a simple, facile and economical method for fabricating large area SERS-active substrates. This was realized via guided self-assembly of gold nanoparticles using an electrostatic pattern formed by amphiphilic block copolymer. The formation of a high density ordered array of gold nanoparticle clusters with <10 nm inter-cluster separation over large area result in a high density of electromagnetic "hot-spots" for delivering strong SERS signal. The variation in SERS signal over a 4" area is less than ±10% when tested with 1-naphthalenethiol. The low variation will bring us a step closer to quantitative measurement, an aspect which still remains a challenge for SERS. Further, a 'stick and peel technique' was adopted to transfer the gold nanoclusters onto a flexible tape. The key advantage of such substrates is the flexibility they offer for incorporation onto irregular surfaces such as fruit skin, fabrics and other non-planar surfaces where flat chips find themselves non-adaptable.This demonstrated approach paves the way to significantly low-cost and high throughput production of SERS substrates for real world application.

Reflections
The 9th Asia Nanotech Camp 2016 was held for the first time in Austria, Europe. I signed up for the camp without knowing what to expect. Now that the camp has concluded, I must say that I am very pleased with what I have learnt and gained from the camp.The camp was held over 5 days, its activities include site visits to research institute and university, sharing of research and debate on nanotechnology issues by camp participants, a one day workshop on Nanosafety, and the BioNanomed conference.On the first day, we visited AIT Austrian Institute Technology, Austrian's largest non-university research institute where we were introduced to the Molecular Diagnostic business unit. Their focus is on saliva based diagnostics for disease detection and therapy monitoring. It is a multi-disciplinary program covering biomarker development, bioninformatics, assay development, diagnostics biosensors and system integration. I feel that the unit has a very clear direction and being able to draw relevant expertise from various groups, they will be able accelerate R&D.The second day consisted of a series of research presentations by camp participants. Each of us gave a short 5-8 minutes presentation on our research work and shared the safety and sustainability issues related to our research. Through the brief presentations we were able to get the gist of the research interest for each of us and this subsequently led to further discussion over tea breaks. This was followed by debate on impact of nanotechnology and sustainability issues. I was assigned to the group debating for advantages of nanotechnology. My group representative, Mona, presented on the numerous benefits towards healthcare. Beyond technical advantage, nanotechnology will have significant economical and societal impact. On the third day, we attended a workshop on nanosafety and concepts of nanorisk and governance. With an ever growing number of nano enabled products in the market, it is inevitable that an increasing amount of nanomaterials will be released to our environment. One of the talks provided statistics on the amount of engineered nanoparticles that was found in the rivers in Austria, which suggest that nanosafety issue is right at our door step. Currently, we do not have full understanding of how these engineered nanomaterials can affect our ecosystem and human health. It is critical that governance and technical assessment is in place to ensure nano-enabled product do not harm our environment.

The camp increased my awareness on issues regarding nanosafety and sustainability. In the past, my research focus is on device performance, manufacturing scalability and cost effectiveness. This camp prompted me to give thoughts to how I can contribute to safe and sustainable development in my field of research. As scientist, we should ensure that the nano-enabled product that we innovate is safe and sustainable at various stages of the product cycle, this includes environmental friendly manufacturing and packaging processes, no negative health effect on the product user and minimal nano-waste upon product disposal. With a small group of 24 participants from 10 different countries, we had the opportunity for networking and bonding over the five days. I have benefitted tremendously from this camp, and hope that the meaningful work by ANF will spread beyond the Asia-Pacific region!

Finally, I like to thank Dr. Andre and Dr. Lerwen for their valuable guidance, the organizers for making the camp possible, and the financial support from Ministry for Transport, Innovation and Technology (Austria) and IMRE. Last but not least, thanks to all fellow participants for your friendship and making the camp a memorable experience for me. I hope we will meet again somewhere, sometime in future!

Taiwan

Shun-Min YANG, PhD.
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Keywords: Translational medicine, renal pathology, molecular biology, nanoparticle synthesis, super-resolution microscopy
Research Interests:
I am interested in research of pathogenesis of renal disease by using mouse model. We found out that oxidative stress and inflammation play important pathologic roles in renal disease. We screened several anti-inflammatory and anti-oxidant activity of pure compounds from herbal grass and successfully applied to mouse nephritis model such as IgA nephropathy, focal segmental glomerulosclerosis for treatment. Recently, I joined Institute of Physics, Academia Sinica, with my research field being high-resolution X-ray biomedical imaging. Using such technology allows for the clear observation of the distribution of microvascular in the kidney, along with

observations in the changes of the glomerular vascular plexus patterns. In addition, images taken with the technique can be reconstructed into a 3D image where the renal blood vessels can observe in a more complete manner. The results of this research would provide a lot of help in the future diagnosis of related diseases as well as fundamental research in such fields.

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Abstract of presentation

Our work mainly involves the synthesis of gold nanoparticles (Au NPs) by using synchrotron x-ray radiation in the presence of alkanethiolate, such as 11-mercaptoundecanoic acid (MUA). The synthesis products have high colloidal density as well as excellent stability, shelf life and biocompatbility. In addition, this radiation method not only allows us to control the size of Au NPs but also facilitates functionalization. For very small Au NPs, the optimization of their photoluminescence intensities and quantum yields can be easy to reach by varying the carbon chain lengths of the coated alkanethiolates.

Further characteristic analyses of the Au NPs were also performed, such as the tests for cancer cell toxicity. It found that the cell survival rate can reach 80% up when the gold concentration is less than 1mM. Applications of the Au NPs can be extended as a contrast agent, which used in high spatial resolution X-ray tomography imaging for the angiogenic microvessels of brain glioma tumors.

Reflections:

It is my pleasure to join this Asia nanotech camp. I gained a lot of knowledge about the nanotechnology safety and risk governance, and it also broadens my experience in nanotechnology. The most important thing which I gained in this Camp is to not only focus on my study, but also need to think about attenuating the environmental hazards of my research and subsequent development of my research field. With this camp, I learned about the newest progression of nanotechnology with other countries in Asia from other participates and also recognized many research partners in the nanotechnology field. What is great is that it creates the potential for cross-border cooperation with these partners in the future.

The good aspect of the curriculum such as oral presentation with every participant is that we can get the experience of how nanotechnology is applied in different fields. The debate course has a strong impact on me because it is the first time for me to debate in English. Through the group discussion of the debate topic, we became familiarized with our team members from different countries rather quickly, and it also trained our ability to communicate and integration capabilities. We were able to move from strangers to active participants due to the debate course. One of the topics in this camp is to explore the pros and cons of nanotechnology: As a scientist we are always used to defending the direction of our research. However, through the camp I have to start thinking about my impact on the environment and examine whether and how sustainable is the research. Another focus of this camp is nanotechnology risk governance. Through the courses I also gained a lot of new knowledge regarding management regulations of nanotechnology. A highlight of this camp is the international biomedical nanotechnology congress which was an excellent integration to the camp. As my research field has a high degree of association with biomedical field, I gained a lot of news of nanotechnology in biomedical applications, such as a biosensor, detector, and imaging.

I enjoy my time in Austria with its cultural atmosphere and I am also impressed with the nanotechnology development in this country which should not be underestimated. It is a breakthrough and a pioneering move to hold the Asia Camp in Europe. I believe to break the barriers between regions and to move towards globalization is necessary for the sustainable development of the camp going forward. I would also like to make use of this opportunity to thank Dr. Gazso' and Dr. Liu for their organizing this camp.

Tsung-Ju LI, PhD Candidate

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Keywords: nanomedicine, nanotechnology, cancer biology, hyperthermia

Research Interests:

My research focused on biological interaction between iron oxide nanoparticle and cancer cells. Through diverse surface engineering on nanoparticles, we can enable localized triggering of drug release to improve therapeutic efficacy and reduce systemic side effects. While recent studies showed that cancer initiating cells or cancer stem cells are strongly linked to therapeutic failure and tumor recurrence. My study would like to demonstrate the potential of using nanoparticle as the cancer theranostic tool and enlighten the therapeutic opportunity for future cancer patients.

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Abstract of Presentation:

Nanomedicine is emerging as a new approach for the advanced management of diseases through comprehensive multimodal therapeutic integration. In this research, we present novel polynucleotide conjugated magnetite nanocrystals that carry 5-fluouracil

and target human epidermal growth factor receptor 2 (HER2). The nanocrystals synchronize localized drug release and hyperthermia triggered by radiofrequency energy, and the anti-HER2 antibody targets cancer cells that overexpress HER2. Tumor size significantly shrank in response to radiofrequency-induced hyperthermia, and hyperthermochemotherapy more effectively shrank the tumor than did hyperthermia alone.

Reflections

11th Asia Nanotech Camp 2016 (ANC2016) was hosted by the Austrian Ministry for Transport, Innovation and Technology in cooperation with the Austrian Academy of Science and the IMC University of Applied Sciences Krems. This program aimed for young nanotechnology researchers (Ph.D. or Ph.D. candidates) to learn about the current cutting-edge nanotech advancements. During this program, I learned from top researchers from Austria about their nanotechnology development toward point-of-care. I also experienced wonderful tour to the Vienna Technical University clean room and was introduced with different expensive instruments for processing their silicon based chip or customized microfluidic chips. Total of 9 well-known speakers from Europe and Asia gave their perspective view on nanotechnology impact on the environment. Prof. Sirirurg SONGSIVILAI from National Science and Technology Development Agency, Thailand, have gave us first-hand information how nanotechnology has already entered Thailand consumer cycle. The benefit of nanotechnology has already improved their economy because it added extra value and lower the production cost. Being a researcher and a consumer in the nanoproduct ecosystem, we are responsible for what we synthesize because it will shape our world tomorrow.

Dr. Liu, the founding secretary of Asia Nano Forum and Dr. Andre GAZSO, Chair of the Austrian Nanoinformation Commission, gave all the camp members an insightful talk about Safety and Sustainable Development of Nanotechnologies and the Responsible Innovation Towards Sustainability. The debate focused on what are the risk and sustainability of our current development. I was quite excited to learn from other professionals with different backgrounds and obtained many inspiring conclusions. With the ending of the Asia Nanotech Camp on 4/6, began the BioNanoMed conference with two consecutive days. The BNM conference is paid by BMVIT and is part of the 2016 ANC. This is an excellent opportunity to hear keynote speakers presenting their cutting edge nanotechnology in medical application. Among these outstanding keynote speakers, Arben Merkoci, ICREA Professor and director of the Nanobioelectronics & Biosensarben Group at Institut Català de Nanociencia i Nanotecnologia (ICN) gave me the most inspiration thoughts. It is amazing to listen that every researches his goup has done aimed for practical applications and valuable for the medical fields. Most of his studies published on high impact journals and translated into many prototype devices.

I sincerely appreciate the ANF and Austrian program office for the kindly supporting of this trip. This support definitely opened my vision and again charged up my research motivation energy. The opportunity to interact with the world's top Ph.D. members in the nanotechnology fields allows me to share valuable experience with my lab colleagues. My presentation also allowed the world to know Taiwan research power and development in nanotechnologies. I will strongly recommend other young talented scientists to take this Asia Nanocamp that will be held next year.

Thailand

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Keywords: Nanomaterial based field effect transistor (FET), biosensor, chemical sensor, nanoelectronics, nanomaterial synthesis and assembly

Research Interests:

My research interest mainly focuses on fabrication of field effect transistors (FET) using nanomaterials as the active material for sensing applications. Nanomaterials have larger surface to volume ratio than the bulk form for molecular binding and their comparable size to biomolecules and chemical species making them ideal for the sensing material and highly sensitive. In addition, FET based sensors are real-time and electrical detection which can be easily integrated with peripheral circuits. Currently, I am working on improvement of metal oxide nanoribbon FET sensors for biomolecular detection and exploring in other prospective applications. Besides, I am also interested in synthesis and assembly of nanomaterials such as nanowires, nanotubes, and nanoribbons in order to investigate their properties for electronic and sensing applications.

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Abstract of Presentation:

Nanostructure field-effect transistor (FET) biosensors have shown great promise for ultra sensitive biomolecular detection. Top-down assembly of these sensors increases scalability and device uniformity but faces fabrication challenges in achieving the small dimensions needed for sensitivity. In this talk, I will present about top-down fabricated indium oxide (In2O3) nanoribbon FET biosensors using a simple 2 mask photolithography process and highly scalable radio frequency (RF) sputtering to create uniform channel with high yield. The electrical properties of devices showed good uniformity in on-state current, on/off ratio, mobility, and threshold voltage. In addition, the sensors show excellent pH sensitivity over a broad range as well as the physiological range. Next, I will introduce combination of this scalable sensing platform with the electronic enzyme-linked immunosorbent assay (ELISA)

technique to amplify signal from target analytes through the enzyme-substrate reaction. Our approach circumvents Debye screening in ionic solutions and detects p24 protein, a biomarker for Human Immunodeficiency Virus (HIV) Infection, at 20 fg/ml in human serum or about three orders of magnitude lower than the commercial ELISA. With the demonstrated sensitivity, scalability and uniformity, the In2O3 nanoribbon sensor platform makes great progress toward clinical testing, such as for early diagnosis of acquired immunodeficiency syndrome (AIDS).

Reflections

As a representative from Thailand, I am pleased to have a chance to attend this Asian Nanotech Camp 2016 in Vienna and Krems, Austria. Our activities are composed of various activities: site visits, own research summary presentation, debate, lectures on safety and sustainability related to development of nanotechnology and research presentation in BioNanoMed 2016. My essay will summarize on my experience for all activities mentioned earlier.Our members of ANC2016 have a chance to visit Department of Molecular Diagnostics of Austrian Institute of Technology (AIT) located at Tech Gate Building, Vienna. We listened a brief presentation about research activities in Department of Molecular Diagnostics. Their research interests are ranging from optical waveguide, electrochemical and magnetic based biosensors. After that, we were brought to their fully equipped characterization instruments, cleanroom, device fabrication facilities and research laboratories. Later, we commuted to Institute of Solid State Electronics, Vienna University of Technology and attended an introduction presentation of the institute and had a chance to take a lab tour into their cleanroom facilities and research laboratories.

In the ANC meeting, I had a chance to briefly introduce my research interest about top-down fabricated indium oxide nanoribbon field effect transistor based sensors to other participants and discussed about safety risks from my research and how to make my research more sustainable. I have contributed to my debate team in the topic of "Sustainability Driven Innovation by Individual" that we could divide into two major contributions: individual and policy. In term of each individual, we could contribute to sustainable development or innovation by promoting good practice of whole supply chain or innovative ecosystem, being responsible for recycling, and being more cautious for consumption to reduce waste generation. In term of policy, each government should promote and reward companies and individual who follow good practice for sustainable development and innovation. In the mean time, government should have a penalized system to enforce whoever breaches its guideline. In addition, government should educate people to raise awareness about sustainable development and innovation to emphasize cause, consequences and solutions to problems. To raise our awareness about safe and sustainable development of nanotechnology, all participants had a chance to listen to a series of lectures provided by ANC 2016 committees. After lectures, I have developed more understanding about safety and sustainability in nanotechnology, its importance, and consequential outcomes of nanotechnology toward our environment and ourselves. Additionally, I have been framed my thought about my research to minimize any risk to our environment and to be more sustainable.

In the last program of ANC 2016, I have a chance to attend BioNanoMed Conference during April 7-8, 2016 of which one theme, "nanotechnology for detection, diagnosis, imaging and sensing," is fitted with my research interest. Key note, invited lectures and research presentation were interesting and beneficial to my research. I have discussed challenges in my research with some of speakers and how they solved their problems.In summary; I have gained more understanding about safe and sustainable development in nanotechnology and realized its importance to our environment and human race. From this knowledge, I will try to perform my research in more sustainable approach and spread this idea to my friends and colleagues to contribute to safe and sustainable development of nanotechnology in Thailand.

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Keywords: polysaccharides, nanoparticles, chitosan, nanocarriers, drug delivery system

Research Interests:

My research is focused on synthesis and preparation of polysaccharides nanoparticles. Based on different chemical structures of polysaccharides, the nanoparticles can be fabricated using charged interaction or self-organisation method. With the use of non-toxic solvents, this developed techniques would give the benefit for various applications. The polysaccharide nanoparticles obtained in this work can be used as a nanocarriers in order to encapsulate and deliver of various active compounds such as drugs, vitamins, crude extracted from plants as well as some small molecules. Moreover, our developed system were concern with utilization of non-toxic solvents in the fabrication processes that made a benefit and innovation for various applications.

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Abstract of Presentation:

Nanotechnology is an interdisciplinary field of technological developments on the nanometer scale offering comprehensive applications to biomedicine. Due to their nanosize and possibility of surface modification, these nanoparticulate systems possess several advantages over other forms of conventional delivery systems. To date, most of the advanced nanocarriers have been

developed by utilizing either synthetic polymers or polysaccharides as well as by their combination. Among the various materials available, polysaccharides is one of the most widely used biopolymers for the preparation of nanocarriers. Natural polysaccharides have become increasingly excellent materials and have attracted more and more attentions due to their outstanding merits such as easily available, non-toxic, biocompatible, biodegradable, and easily modified. Moreover, polysaccharides offer a green alternative to synthetic polymers in the preparation of soft nanomaterials. Herein, the developments in the preparation of polysaccharides-based nanoparticles will presented. Two techniques are focused on to fabricate polysaccharides-based nanoparticles, that is, ionotropic gelation and the self-assembly of hydrophobically modified polysaccharides. Different applications of polysaccharides based-nanoparticles on medical and pharmaceutical are described.

Reflections

Throughout all site visits and lectures, my research goal is to design synthesis and fabricate nanoscale soft materials with integration of science technology and innovation for sustainable development. A hazard exposure of these material is our concern. Therefore, we aim to design materials and fabrication processes that are safe, energt efficient and reduce waste. Starting materials are based on renewable materials and processes have a low net impact on the environment. Chitin/chitosan is one of the most plentiful bio-renewable resources. It is the major waste product of shrimp and crab industry. Synthesis and fabrication processes can be improved such as using the bulky/ or non-toxic solvent method. The chemical modification should be occurred at ambient temperature.

Nanotechnology has rapidly promoted as a new generation of smart and innovative products and processes for a large number of industry sectors. Engineered nanomaterials (ENM) with the useful properties have created and continually developed to be fully utilized in a number of nanotechnology applications. However, the potential risks of ENM and nanotechnologies are important to consider. The relationship between man and nature is an important factor for sustainable development. Green nanotechnology can be applied to produce safer and more sustainable nanomaterials and more efficient nano manufacturing processes. Sustainability-driven innovation should be considered about the social relation and the organization of society.

Key challenges today is to provide a strategic vision for future research to promote the safe use and applications of nanomaterials.

Vietnam

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Keywords: Drug delivery system, self-assembly of nanoparticles, multi-stimuli responsive nanoparticles, cancer therapy

Research Interests:

Dai Hai Nguyen obtained Ph.D. degree at Ajou University -Republic of Korea in 2013. Currently, he works as a researcher at Institute of Applied Materials Science-Vietnam Academy of Science and Technology. Dr. Nguyen is interested in design and evaluation of multi-stimuli responsive and self-assembly of nanoparticles for drug or/and protein delivery, preparation of *in situ* hydrogel systems for tissue engineering (bone regeneration, *bioadhesive*) as well as synthesis and biological evaluation of drug activity. Recently, he has received several grants in such fields. Besides, he is an invited lecturer in Tra Vinh University and Ho Chi Minh City University of Natural Sciences. His teaching and studying areas are Biochemistry and biomaterials for biomedical applications.

References:

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[2] DH Nguyen, JW Bae, JH Choi, KD Park, Targeted doxorubicin nanotherapy strongly suppressing growth of multidrug resistant tumor in mice. International Journal of Pharmaceutics, 2015; 495(1):329-35
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Abstract of Presentation:

Cancer is one of the leading causes of death worldwide and chemotherapy is a major therapeutic approach for the treatment which may be used alone or combined with other forms of therapy. However, conventional chemotherapy has the potential to harm healthy cells in addition to tumor cells. Using nanoparticles to deliver chemotherapeutic agents in cancer therapy offers many advantages to improve drug delivery and to overcome many problems associated with conventional chemotherapy. Our work was preparation of nanocarrier-based drug delivery systems such as nanogels, magnetic nanoparticles, liposome and dendrimer for targeted therapeutic application. Such nanoparticles show a high drug-loading and a slow release profile of anticancer drug. The cytotoxicity of the nanoparticles on NCI-H460 (lung cancer) cells, MCF-7 (breast cancer) cells and HeLa (cervical cancer) cells were lower in comparison to free drugs. In vivo tumor xenograft study, anti-cancer drug encapsulated nanoparticles exhibited a significant decrement in volume of tumor which was generated by MCF-7 cancer cells. These positive results could pave the ways for further researches of the drugs nanocarriers towards to cancer chemotherapy.

Reflections

It's such an honor for me to be invited to 9th ANC Workshop. It was a wonderful opportunity either to develop and improve my research or to interact and communicate with colleagues in different countries. The 2016 ANC was a very exciting and well-organized experience, where I was able to listen and discuss my project with other faculty members in various area of nanotechnology. From the beginning, the workshop had a friendly atmosphere, I am blessed with some wonderful friends who listened, argued and made suggestions as I began to formulate my ideas. During at that time, all the professor's arguments were aimed at giving advice to improve the research. This was such a memorable experience for me.
Moreover, I not only had the opportunity to visit to the Technical Vienna and Austrian Institute of Technology but also took a guided tour through Vienna to see many breathtaking views. All of this happened in the beautiful country, Austria.

Herein, I just highlight drug delivery system (DDS), a kind of particular nanomaterial system for pharmaceutical applications, especially in cancer treatment. DDS has been an impressive subject of studying and developing as an original method to control drug release in the blood stream for reducing toxic side-effects in patients. The main purpose of DDS is to particularly localize and target the drug within desired therapeutic range to expected tissue and cells while maintaining the systemic level of drugs. This system possess numerous advantages (1) the association between drugs and nanoscale carriers are distributed over extremely small volumes (2) pharmacokinetics and distribution of drug are increased (3) doses are minimized leading to decreasing of toxicity as a result of specific targeting, and delivery of payload is easily because of permeable vasculature of nanomaterials (4) solubility of hydrophobic therapeutics is improved in aqueous medium (5) the stability of various therapeutic agents (hydrophobic molecules, peptides, and oligonucleotides) is gained (6) the biocompatibility of nanomaterials is highly safe. In order words, the tiny size of nanomaterials allows them to pass through endothelium in tumors, epithelium, inflamed site, or penetrate microcapillaries, and raises the surface area and enriches the structure of nanomaterials, therefore enhancing the solubility of poorly soluble drug and prolong circulation half-life of drug. Moreover, nano-carriers can be non-selective uptake by reticuloendothelial system and passively reach the target tumors based on enhanced permeability and retention (EPR) effect. Due to the presence of many fenestrations in the endothelium of tumor vessel, nano-carriers easily enter into the tumor tissue by enhanced permeability effects. Besides, tumor tissues lack of lymphatic system which prevents the catching of nano-carriers, retention effects. After targeting solid tumors, non-specific cell uptake of nanogels occurs by endocytosis process and then complex endocytosed nano-carriers come at nuclear membrane where nano-carriers release drugs to successfully kill cancer cells. According to these promising characteristics, DDS can open up a new range of feasible therapeutic possibilities for developing safe and effective system for cancer therapy. We expect that the use of nanotechnology in drug delivery could offer a significant opportunity for improving human health.

In conclusion, the 2016 ANC not only did it give me a valuable chance to gain self-confidence about my work, but it also inspired me to continuously work hard for the purpose of developing a safe and effective drug delivery system in cancer therapy. And last but

not least, it is an amazing privilege to attend the 2016 ANC and to be a member of the nanotechnology's student body. And of course, I would like to thank the organizers for creating such a stimulating intellectual and understanding home.

VU Thi Thu, PhD.
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Keywords: microfabrication, microfluidics, lab-on-a-chip, biomedical, solid/liquid interfaces, biosensor, electrochemical, semiconductor, conducting polymer, metal nanoparticles, mussel-inspired surface chemistry, capillary electrophoresis, protein separation

Research Interests:
My research interests are concerned to Nanomaterials for biomedical applications, including metal nanoparticles and polymer thin films. Recently, I focus on development of microfluidic devices for bio-sensing applications and synthesis of biomedical nanomaterials.

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Abstract of Presentation:
In this study, a poly (methyl methacrylate) (PMMA) microfluidic device fabricated by inexpensive CO2 laser etching system was developed for detection of carcino-embryonic antigen (CEA). The device was capable of working in continuous mode and was designed with the aid of numerical simulation. The detection of target CEA was based on immuno-assay via magnetic particles and electrochemical sensing. The as-prepared microfluidic can be used to detect CEA at relatively low concentration of 150 pg.mL-1. The device could be reused many times since the capture and removal of magnetic particles in the assay could be manipulated by an external magnetic field. The proposed approach appears to be suitable for high-throughput and automated analysis of large biomolecules such as tumour markers and pathogens.

Reflections
Lemon tree – Dear Austrian friends, please accept my apologies to be honest and must say that Krems is a 'lemon tree' town in my mind. I mean that everything just slowly happened as time gone by and we weren't patient enough to notice. Every morning, I look through the window of my hotel room and wait for some passengers but no one pass. When I walk down street, I have never hit to someone going toward me. Even if I just stay in a coffee shop and watch people, I can record all motions in a very slow movie. It must have been long time I didn't find such a great place! Wish to have another opportunity to come back this beautiful town for longer period to completely enjoy that peace.
Energy – I do still remember how you were heating up the rainy days in Krems. Each ANC member has certain characters, but we are all dynamics and enthusiasm. I believe that Andre and Lerwen must have been jealous with our youth. I am really thankful to your efforts to save our team, Kelvin. I was also very impressed with the debate between team C and D.
Responsibility – Trust me, this is the first time I think that what I am doing might have certain serious impact on our tiny Earth. I was honest to say that I started to be scared to continue my research. But for sure, I will still move on but on a more safe and sustainable way.Wish to see you in the next ANC so that we will hold the hands together to figure out how to develop safety and sustainable nanotechnology!

Austria

Nicole HUBER
IMC Krems
Stem Cells, Aging and Neurodegeneration group, Lund Stem Cell Center, Department of Clinical Sciences, Lund University,
E-Mail: nicole.huber@imc-krems.eu

Biography:
Areas of expertise: Stem Cells, Cell Biology, Neuroscience, Molecular Biology, Immunohistochemistry, Fluorescence Microscopy, Microscopy, Neural Stem Cells
LABORATORY METHODS AND SKILLS

- Cell culture laboratory
- Organotypic 3D growth of endothelial cells and neurospheres
- Passaging cell lines and primary cultures
- In vitro assays of migration and invasion of tumor cells and neurosphere assays
- Genetic Engineering Laboratory under GLP
- (Sub)cloning and colony PCR
- Expression of the D1.3Fv protein in E.coli, purification of the protein on Ni-NTA agarose, analysis of the protein expression and purification by SDS-PAGE gel electrophoresis
- Microbiological Monitoring Techniques

Additionally applied in a project cooperating with companies:

- Project Leader of the project “Testing of the BMB-procedure”
- StuCon Junior Enterprise e.V. in cooperation with
- BMB Gebäudehygiene GmbH and Noack & Co. GmbH, Krems (Austria)
- BMB-Procedure, which is a 4 step method to remove mold in private households and in industry.

WORK EXPERIENCE
Jul 15 – Feb 16 "Adult Neural Stem Cells and Neurogenesis - Role of Aging and Inflammation"
Work on the project "Dynamic Role of Chemokine receptor CXCR5 in Adult Neurogenesis" in the lab of Henrik Ahlenius which is focused on, neural stem cells, neurogenesis, Aging, Neurodegeneration and academic research. Tasks included: Cryostat and microtome sectioning, immunohistochemistry, immunocytochemistry, fluorescence microscopy, RNA isolation, Q-RT-PCR as well as culture of adult and aged neural stem cells

Abstract of presentation
Ageing is a major risk factor for developing neurodegenerative diseases and chronic disability. Neurodegeneration often emerges together with a decline of neurogenesis and an increased immune response. C-X-C receptor 5 (CXCR5), which is binding to C-X-C ligand 13 (CXCL13) occurs particularly on lymphocytes, such as B- and T-lymphocytes. Furthermore, it has been suggested that CXCR5 has a regulatory function in neurogenesis in adult Zebrafish. In mice CXCR5 might be responsible for both an enhancement of proliferation of subgranular zone cells in the hippocampal dentate gyrus and a reduction of maintenance of immature neural cell populations. Knockout of the receptor in mice has been reported to increase the density of M1 macrophages and injury after stroke. Moreover, in CXCR-/- mice an decrease of proliferation in the dentate gyrus and an increase of immature neural cells. However, the underlying mechanisms how and to what degree CXCR5 impacts neurogenesis, is so far unknown. Our in vivo data shows, in contrary to previous studies, that the proliferation is increased and the number of neuroblasts decreased in CXCR5-/- mice. Our results suggest that CXCR5 is expressed in subventricular zone derived NSPCs which is rapidly downregulated during differentiation, together with a drastic increase of CXCL13 expression. Our data demonstrates that CXCR5 influences early NSPCs fate, and might be needed for proper neurogenesis. Better understanding how CXCR5 acts in neurogenesis could ultimately lead to the development of new clinical therapies for neurodegenerative diseases.

Reflections
I have been a student at IMC Krems university of applied sciences for 5 semesters, and have participated the Asia Nano Forum 2016 (ANF 2016) for the first time. I came to this event already with a great curiosity and excitement for nanotechnology. I have listened to the numerous of presentations with a lot of attention. Going through the ANF 2016 has taught me so much about what is going on in the nanotechnology area, and more it has let me meet so many interesting personalities. I have learned here how to think differently, and the whole conference thought me to think beyond my horizon and outside of the box. Most importantly I have learned how important risk management and sustainability are.
It was a pleasure and great benefit to participate the very valuable conference. It was a great gain of knowledge and I am very grateful that I had the possibility to participate.

Patrick RERICHA
IMC Krems
E-Mail: Patrick.rericha@imc-krems.eu

Biography:
After finishing the Natural Scientific Federal Senior Class Grammar School in St. Poelten, Austria, Patrick decided to start the ASIIN accredited degree programme Medical and Pharmaceutical Biotechnology at the IMC University of Applied Sciences in Krems, where he is currently in the final semester. During his study Patrick was awarded a merit scholarship. As part of the degree programme he was doing an internship, which he chose to conduct at the Dr. Mark KOTTER laboratory in the Anne McLaren Laboratory for Regenerative Medicine at the University of Cambridge. There he acquired various techniques as designing gene targeting strategies using the CRISPR/Cas9 system, culture and differentiation of human induced pluripotent stem cells and organotypic brain slice culturing of rat and mouse brains. In the course of this internship Patrick had the chance to pitch for a grant at the SynBio Fund at the University of Cambridge, where he successfully helped to secure the funding for his lab.

Abstract of presentation
A major challenge for the pharmaceutical industry is the development of relevant model systems in which knowledge gained from high-throughput, genomic and proteomic approaches can be integrated to study function. The level of complexity of high-content systems is steadily advancing and in vitro functional bioassays based on organ systems are rapidly emerging as an important new interface technology between discovery and development. Animal models are still the main choice for such studies but over the past few years powerful new in vitro systems have begun to emerge as useful tools to study function. Organotypic cultures made from slices of explanted brain tissue represent a complex multi-cellular in vitro environment with the potential to become powerful tools in the arsenal of drug discovery technology, lying at the interface between high-throughput screening and clinically relevant pre-clinical animal disease models. They can act as a useful starting point for refining molecules for further in vivo analysis and reduce the number of potential leads one needs to evaluate in animals. The results gained will be of immense importance to the field of CNS remyelination as currently no therapies exist to treat disabling demyelinating diseases like multiple sclerosis.

Reflections
Being the first conference I ever attended to as a speaker I did not know what to expect of the Asia Nanotech Camp (ANC). I believe that my university felt the same as it was the first ANC to take place in Austria. From the first moments it was already clear that the Asian delegation that visited us at our university was a group of experts in their relative fields and their knowledge in their individual area of research was impressive. I learned a lot about future technologies and always thought it to be a pity when the speakers had to finish their talk early due to organisational reasons. I wanted to see the rest of the story. Nonetheless my curiosity was satisfied in the social events that took place in between the workshops and after them at the dinners we had together. There I also got to know each of the speakers a bit better and found out that their excellency did not end at their respective research field but that they are also amazing and friendly people in private.

However, getting known to astonishing researchers and to learn about exciting innovations in the area of nanotechnology was not the peak of the event. In my opinion the biggest win for the participants of the ANC was the invitation by Dr. Lerwen Liu to the scientists to think about the consequences of their research, in an economic, social, but also environmental aspect. Her goal was to create awareness about the sustainability of the innovations we are all eagerly working on and I think that I can talk for my colleagues, who also had the opportunity to be part of this event, that she achieved that goal and that she managed to encourage us to change our way of thinking, when it comes to the sustainable use of resources for our research. I am a mere bachelor student yet and I do not know where I will end up in the future, yet I am sure that this Asia Nanotech Camp will influence not only my future professional choices, but also the way I think of sustainability in everyday life.

I was proud to be part of the first ANC outside of Asia and I am glad to have met so many admirable people. I would be happy if I meet them again soon at any other conference. I furthermore believe that this conference was a big opportunity for the exchange of cultural values and for the strengthening of the relationship between Asian scientist and not only our university but also Austria itself.

Isabella WINTER
FH Krems
E-Mail: isabella.winter@imc-krems.eu

Biography:
Isabella Winter is a student at the University of Applied Sciences Krems in the study programme "Medical and Pharmaceutical Biotechnology" and for her practical training semester abroad she decided to try something new. She decided to follow several of her passions, which include science, communication and education as well as art and creating. She united her talents by working at the American-based scientific animation company XVIVO for six months, had the opportunity to gain an insight into their work and is now eager to spread her experiences and enthusiasm. She is planning to follow the path of medical education in her future career and make scientific animation "the next big thing" in Austria and Europe

Abstract of presentation:
The advancement of knowledge and technology in the field of natural sciences over the last decades has opened up the doors for a new professional field: scientific animation.
Biotechnology and its applications are nearly ubiquitous, but at the same time highly complex and abstract and thereby not easily imaginable and understandable. With the help of three-dimensional visualization of molecular processes, scientific animation aims to make biotechnological knowledge accessible to the broad public by combining a narrated story with moving images. Animated movies, made by artistic scientists or reversed, aid among others in commercialization of pharmaceuticals or patient education.
This talk aims to demonstrate the importance and benefits of scientific animation in Biotechnology and other medical fields, by presenting hands-on experience and will also give an insight into the path from an idea to a scientific animation by presenting self-directed work.

Reflections:
When I applied for being a participant and speaker at the Asia Nano Camp 2016, little did I know what would be awaiting me in those few days. Now, as I look back at the event there are lots of thoughts crossing my mind, which I am going to share with you. You have to imagine this situation: Around 25 young people in a room, the majority of which does not know each other at all, attending a workshop on Nanotechnology. Everybody is nervous because they have to hold a presentation sooner or later. But as soon as the first presentation started, I realized that there is so much I can learn from everybody in this room. Every participant is an expert in their field of research. I got an insight in a variety of fields connected to Nanotechnology and I have definitely learned a lot.

As we gathered and prepared for the debate topics, we already got to know each other better and it was fun to think our way into different scenarios and topics. I liked the setup of the debate: four teams and two topics with opposite views. My thoughts on the first part "Nanotechnology Application and Implication" are: There is great benefit but also great risk connected to Nanotechnology – whereas I think that the benefit outweighs the risk and that in the position of a researcher you are obligated to have a responsible approach to this topic. Concerning the second part of the debate "Sustainability Driven Innovation – Technology and Me", where I belonged to the team of individual sustainability, both teams came to the conclusion that neither technology nor individual driven innovation alone will have a long term positive effect. It needs a combination of both to be truly successful.

The person that influenced me and my way of looking at things the most throughout this event was Lerwen. Not only was she involved in organizing the event and held a great talk on sustainability, but she also guided us through the event and repeatedly emphasized the importance of a sustainable way of thinking in research and Nanotechnology. Her strong personality and passion for sharing her matter of the heart (sustainability, obviously), caused a sustainable mindset in every area of my life. To sum up, I want to say that being a part of the ANC 2016 was truly an enrichment to my way of thinking and living. A lot of young persons from different countries and cultures came together to exchange their knowledge and gain new experiences. I had the possibility to broaden my horizons and leave my comfort zone by positioning myself in front of a crowd to present as well as participate actively in a debate.

Daniel GRBAC
FH Krems
E-Mail: daniel-grbac@fh-krems.eu

Biography
Work experience:

- Academic affiliate at the University of Tübingen, Urology, July 2013- Dezember 2013 (72070 Tübingen Germany)
- Academic affiliate at the University of Michigan, Center for Stem Cell Biology, September 2015 – February 2016 (Mi 48109 Ann Arbor, USA)

Education:

- IMC University of Applied Sciences, Master Medical & Pharmaceutical Biotechnology, since September 2014 (3500 Krems, Austria)
- IMC University of Applied Sciences, Bachelor Medical & Pharmaceutical Biotechnology, 2011 – 2014 (3500 Krems, Austria)

Publications:

- Janssens, D. H., Komori, H., Grbac, D., Chen, K., Koe, C. T., Wang, H., & Lee, C.-Y. (2014). Earmuff restricts progenitor cell potential by attenuating the competence to respond to self-renewal factors. Development (Cambridge, England), 141(5), 1036–46. http://doi.org/10.1242/dev.106534

Abstract of presentation

The Company ERBE has developed a novel, patented technique for cutting tissue and injecting solutions using a pressurized water jet. This technique is already being used for treatment of different issues.
Funded by a public grant a 3-year project is started to facilitate the use of the water jet technique to inject cells to investigate cell therapies for treatment of incontinence. The idea is to use the water jet to first cut a small hole into the sphincter muscle and then inject mesenchymal stromal cells (MSCs) to facilitate healing.
This part of the project focuses on developing the basic technique of cell injection to test the novel technique in a minipig model. Therefore, a protocol is developed for optimal growth, differentiation and characterization of porcine MSCs (pMSCs). Additionally, the effects on the pMSCs when applying them using the water jet technique under different conditions are tested.

Reflections:
As I have not heard much about the nanotechnology field in my master's program I was excited to join the Asia Nanotech Camp 2016. I was ready to hear about all the new technologies and applications our Asian colleagues were working on, however, what amazed me the most were the risks and sustainability issues that nanotechnology is facing right now. Until the ANC I did not think much about the dangers of nanotechnology and thought that it will only bring benefit to us and our environment. Through the talks and workshops of the camp I was shown that this was not the case and I realized how easy it is to overlook possible issues when getting excited for a research project. I started remembering how in former projects I was working on I never gave a second thought about what harm might be brought to the environment through the substances I was using. Some I knew I had to collect for special disposal and could not just pour down the drain, however, I did not think about how they would actually be disposed of or how they might become a problem when the new technique or application would be used in our society. In conclusion the ANC definitely changed my way of thinking and how I will approach future projects. From now on I will make sure to not get sucked into narrowly perusing an exciting research topic but to take a step back and take a better look at the bigger picture.

Additionally the ANC allowed me to get to know colleagues from all over Asia. Not only did I hear about what amazing work they are doing in their respective fields but I could also gain a little insight into their different cultures. All the participants of the ANC were very friendly and open making the whole event a very joyful experience. This includes of course the organizers of the ANC who did an amazing job bringing us together and helping everyone to grow as researchers. I am thankful for being invited to be part of such an amazing experience and I am sure that some of the connections I made will help me in the future even if it is just getting advice for a future holiday trip.

Summary

Summaries of ANC-Group Discussions -Nanotechnology Application and Implication (Benefits vs. Risks)
Possible Benefits of Nano
The group named four fields in which Nanotechnology can provide benefits: application in medicine, environmental application, energy applications and energy production.

Examples for beneficial effects of nanotechnology in the medical field were: drug delivery (e.g. polymere medicine for painkillers or hormone products for LHRH), cancer drugs (already on the market) which can target the tumor more accurately (e.g. products such as Abraxane, AmBiosome, Doxil), or the antibacterial effect of silver-NPs (other inorganic NPs used in medical field are ZnO, QDs for biosensors, Superparamagnetic iron oxide nanoparticles – SPIONs - in MRI).

One beneficial environmental application named was the effect of photocatalysis, as well as energy applications, where NPs clear surfaces, reduce energy consumption or even reduce the weight of heavy materials. In the aircraft, nanomaterials are used to reduce weight which makes it possible to save costs and energy.

Currently, the value of nanotechnology was considered to be restricted to certain areas of application. Some of these applications are already on the market, but a lot of them are not yet approved for humans.

Risks/ Possible Damages of Nano

The students differentiated five areas of risk:

1. Real Risk. Concerning health, a lot of nanoparticles could damage your system by using different uptake routes into your body. Here, there is comparatively high awareness, but there are areas of less awareness, e.g. water pollution by nanoparticles. One prominent example is the area of cosmetics: Everybody uses cosmetic products, but there is not much information about the NPs used in it, let alone further impacts of nanotechnology production. One such aspect would be the high energy use for nanomaterial production which is damaging for the environment. Or, more health-oriented, the mixing of methods between nanotechnology and orthodox medicine practices could be problematic.

2. Real risk concerning governance questions, e.g. the impact of nanotechnology on privacy (e.g. surveillance vial microchips), or the question of (global) supply chains where it is impossible to know, under which circumstances is the material obtained (e.g. mining in conflictual regions).

3. Potential risk about an economic upheaval which cannot yet be foreseen, e.g. the side-effects of promised economic booms such as monopolization.

4. Potential risk of nanotechnological weapons for warfare (e.g. neurotoxins).

5. Far- fetched risk of "grey goo" (a term coined by Bill Joy in an article titled "Why the future doesn't need us", Wired Magazine, April 2000) which fears that robots could consume all living matter which is possible in theory, but still not plausible.

Therefore it is no issue for risk governance which cannot deal with non-plausible scenarios. Societal consequences (e.g. inequality questions due to global power relations or 2-class medicine) were not discussed in detail, but taken up in the discussion, especially the second argument.

Summaries of ANC-Group Discussions –Debate: Sustainability Driven Innovation (Technology vs. Individual)

One group pointed out, that a technological fix to global problems such as waste increase and population growth, is no ultimate solution. Referring to the power of individual choice to influence global developments towards more sustainability, e.g. by less consumption, technological developments were not considered sufficient enough. Education, especially environmental awareness, was seen as crucial to provide a basis for informed decision. The second group referred to options for sustainability driven innovation induced by companies themselves, consisting of the principle of circulation between innovation and real-world problems (keeping the technology responsive to peoples' needs), reduction / reuse and recycling through technology. The case study of the driverless car served as an example of technology-based ameliorations of today's driving experiences (e.g. sensors to recognize obstacles).

For more environment-related developments such as water-pollution and waste-problems, one group suggested solutions such as redemption of old products by producers. It was pointed out that technological innovation multiplies individuals' choices to behave sustainable by providing options to do so. This was countered by listing other options to encourage more sustainable behavior such as tax regulations for waste reduction. Also, concerning the case study of the driverless car, the

question of increased unemployment came up. This was answered by the possibility of a shift in employment (towards more highend engineering jobs).

Furthermore, a decrease in social interaction due to technological devices was feared, as well as a loss in human capabilities in the long-run (e.g. driving a car when the driverless car is introduced). Nevertheless, the students pointed out, that generally speaking the benefits still outweigh the throwbacks (e.g. smart phones).

Finally, it was demanded to combine individual and technology thoughtfully and to get companies on board to raise awareness and educate people.

It was concluded, that scientific invention most of the time comes with social non-intended throwbacks (e.g. loss of abilities) which have to be taken into account from the beginning. Scientists should be aware of the responsibilities and the change in the world they introduce through research and development.

After Event Quotes

From Main Organiser---Dr. André Gazsó:
Dear colleagues,
It has been a tremendous pleasure to meet all of you at the 9th Asian Nanotech Campus (ANC2016) in Vienna and Krems and to work with you. I enjoyed the lively discussions and the great atmosphere of cooperation very much. The Asian Nano Formum and its annual ANC is a very important platform to exchange ideas on nanotechnology development and its safe and responsible implementation into the society. So, I do hope that some of the central ideas associated to sustanability and safety will be travel with you and will be disseminated and translated into your research and your own national scientific culture. You are the coming generation of researchers, you will be the messengers and the ambassadors of a technology which will make the world better and safe to live in.
I hope we will meet again some day. In any case do not hesitate to contact me if you will be in Vienna or somewhere near. You will be welcome.
With best wishes for your future plansand kind regards.
From ANF Secretariat---Dr. Lerwen Liu:

Dear ANC2016 participants,

I must say, I am most pleased with the outcome of this Asia Nanotech Camp and impressed by your enthusiasm, team work and leadership!

This is the first time we had European youth participating and I see the amazing harmony, energy and wisdom infused in ANC2016.
This has reassured me that ANF must grow global!

On behalf of all of our ANF members, i would like to express our deep gratitude to our Austrian member for taking this great initiative in hosting the first ANC in Europe and at the BEAUTIFUL Krem Austria.
This has been the most inspiring ANC for me!

From ANC2016 Participants:

CHEN Xiuguo (China):
I think that the main inspiration for me gained from this camp is a thorough consideration about a new technology. Before this camp, I always believe that nanotechnology will undoubtedly have many benefits for everything, which was also the motivation when I decided to pursue my Ph.D. degree on nanotechnology. However, from this camp, especially after listening to several lectures presented by Dr. Ardré Gazsó, Prof., Sirirurg Songsivilai, and Prof. Marion Huber-Humer etc., I realized that even a seemingly good thing will have its potential risks hidden in its behind, just like an old saying said “every coin has two sides”. I think I will pay much attention on another side of nanotechnology during my future research.

ALIBOLANDI Mona (Iran):
In this regard, we made a scientific and friendship network to be connected in the future and maybe we can have the opportunity to work on a joint project. ANC provided the very useful information in the field of risk assessments of new

technologies and sustainability. These are the subjects that I never think about them before. This event made me rethink about the outcome of my research positively and also negatively.

SIM Jieun (Korea):
It was a great opportunity to think about the future of nanotechnology and more which i used to overlook. Thank you all organizers (especially Dr. Lewen Dr. Andre..) and all participants. I was very happy to meet such great people (good relationship) and I wish we keep in touch!

KHENG Tan Lee (Singapore)
It is also dishearten to hear from one of the invited speakers from Europe that their institute also has weak support on nanosafety and sustainability issues. I am extremely grateful that I have the opportunity to attend the 9th Asia Nanotech Camp. It gives me a broader perspective on my and also on others' research work, not technically but on the safety and sustainability impact it could lead to, for our future generations.

Isabella WINTER (Austria)
The person that influenced me and my way of looking at things the most throughout this event was Lerwen. Not only was she involved in organizing the event and held a great talk on sustainability, but she also guided us through the event and repeatedly emphasized the importance of a sustainable way of thinking in research and Nanotechnology. Her strong personality and passion for sharing her matter of the heart (sustainability, obviously), caused a sustainable mindset in every area of my life. To sum up, I want to say that being a part of the ANC 2016 was truly an enrichment to my way of thinking and living. A lot of young persons from different countries and cultures came together to exchange their knowledge and gain new experiences. I had the possibility to broaden my horizons and leave my comfort zone by positioning myself in front of a crowd to present as well as participate actively in a debate.

✧ *Acknowledgement*

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