

ASIA NANO FORUM NEWSLETTER

(ISSUE 28 - Special Edition)

Asia Nanotech Camp 2015

Group Project Executive Summary

ANF Secretariat, Singapore November 2015

Editors:

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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 IMRE

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

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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 ANF Secretary

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

20:00

August 02, 2015 (Sunday)

Arrival	l of	Parti	cin	ants
Amua	OI	гани	cu	anus

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)

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

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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 CREATEDr. 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 MoleculesProf. 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

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09:00	Group	competition ((15)	mins	for eac	h grou	p, 5mins	Q&A) with	Tea	Brea	ιk

- 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

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Invited Speakers



Prof. CHEN Zhong, Prof., School of Materials Engineering, Nanyang Technological University Singapore



Qingyu Assoc. Prof., School of Materials Engineering, Nanyang Technological University, Singapore

Prof. Alex YAN

Prof. T. Venky



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



VENKATESAN,
Director, NUS
Nanoscience and
Nanotechnology Initiative
(NUSNNI), Singapore



Dr. LIM Khiang WeeExecutive Director of CREATE, Singapore



Prof. Andrivo RUSYDI,Department of Chemistry,
NUS,Singapore



WEE, Director of the Surface Science Laboratory, Vice President of NUS, Singapore

Prof. Andrew T.S.



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.

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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:

 $\textbf{Dr. Lerwen LIU}, \ Managing \ Director \ of \ NanoGlobe \ and \ Secretary \ of \ Asia \ Nano \ Forum.$

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 – GroupE: 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.

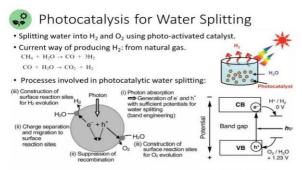
PV energy can be used to break water molecules into hydrogen and oxygen via the so-called photocatalytic water electrolysis. It means that solar energy can be directly stored in the form of hydrogen. Consequently, although the next section deals with the hydrogen economy, we decided to include artificial 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

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.



• The resulting H_2 can be stored in fuel cells to cleanly produce energy. • H_2+O_2 (air) \rightarrow energy + H_2O

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)

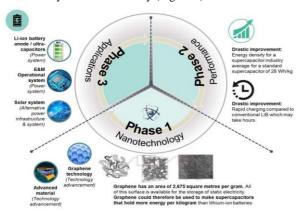


Figure 3: Current advancements in energy storage and its impacts to the industries

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



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

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 whih 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.

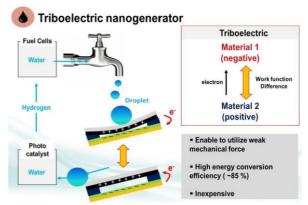


Figure 5: Schematic diagram showcasing the operational mechanism of circular water energy system

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 twodimensional materials.

Second Prize – GroupF: 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)

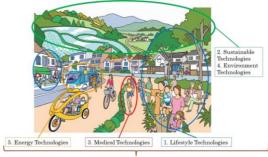
To build Smart City/Nation, Internet of Things (IoT) plays a crucial role.

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)



"IoT" connect all those technologies

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)^{11, 23, 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 expertises 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 - GroupA: 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.

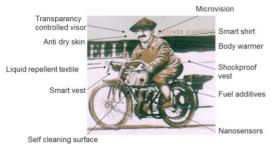


Figure 1: Nanotechnologies in our life

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 antiwrinkle 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

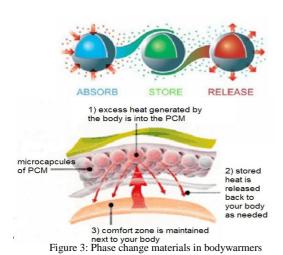
Self-cleaning properties describe materials that repel or degrade dirt or are anti-bacterial. Nano-coatings, nano-structures and nano-particles can be applied to various materials to give self-cleaning properties. Hydrophobic chemicals, most commonly fluorocarbons, can be applied to different materials 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

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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.



Biography



Zengshuai MA is PhD candidate of Tsinghua University. His research interests include microfludic technology and immunoagglutination 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.

GroupB: 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-



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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.

GroupC: 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).

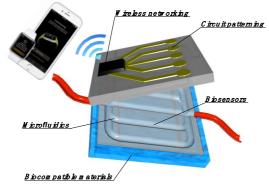


Figure 1. Schematic illustration of "Implantable Diagnosis Device"

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 lungtargeting 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.



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.



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-

: f Develop an Innovative and Sustainable Product Using Nanotechnologies

especials for the grant of the sensitized solar cell

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

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.

(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



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.

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 ₂ O 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 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 processes chemical/electrochemical conversion of 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

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