# Honorary Chair Professor Toyoko Imae's

# Activity Report (2014.1.1~2015.11.20)

**AFFILIATION:**

**(Since April 1, 2009)** Honorary Chair Professor of Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taiwan, ROC
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e-mail : imae@mail.ntust.edu.tw HP : http://imaelab.jpn.org/
and Joint Honorary Chair Professor of Department of Chemical Engineering, National Taiwan University of Science and Technology, Taiwan, ROC

**(Since April 1, 2006)** Professor Emeritus of Nagoya University, Japan

**ADDITIONAL TITLES:**

**(Since October 1, 2011)** Member of Science Council of Japan

**(April 1, 2013 – March 31, 2015)** Visiting Professor under Research Platform Center Program: Tokyo University of Science, Japan

**(Since September 1, 2013, updating)** Visiting Professor under Academic Icon to the Department of Pharmacology, Faculty of Medicine, University of Malaya, Malaysia

**(Since January 1, 2015)** Specially-Appointed Professor of iFront Doctoral Program, Graduate School of Science and Engineering, Yamagata University, Japan

(**Since May 1, 2006**) Life membership of Society of Polymer Science, Japan

(**Since May 1, 2006**) Life membership of Chemical Society of Society of Japan

**(Since September 1, 2007)** Committee Member of Asian Symposium on Advanced Materials

**(Since October 1, 2009)** Member of Women in Engineering (WIE) Committee World Federation of Engineering organizations (WFEO)

**(Since October 1, 2013)** Board Member of Japan Network of Women Engineers and Scientists (JNWES), Japan

**(Since November 1, 2013)** President of Asian Society for Colloid and Surface Science

**(Since April 25, 2014)** Fellow of Japan Oil Chemists' Society, Japan

**Toyoko Imae** was born in Japan. She joined the National Taiwan University of Science and Technology, Taiwan, as honorary chair professor in April 2009, immediately after retiring from Keio University, Japan. She is also professor emeritus of Nagoya University, Japan, since 2006 and a Specially-Appointed professor of Yamagata University (iFront Doctoral Program), Japan. Her major research areas are the fabrication, functionalization, and physicochemical investigation of nanomaterials, including polymers, nanoparticles, carbon materials, minerals and their composites. Her resent research target is a "Nanoarchitecture and Nanotechnology" towards energy, environmental and biomedical sciences. Prof. Imae has published about 310 peer-reviewed journal articles, 25 reviews, 20 patents and 27 book chapters. She also edited three books of *Advanced Chemistry of Monolayers at Interfaces: Trends in Methodology and Technology* (2007), *Neutrons in Soft Matter* (2011) and *Skin Bioscience: A Molecular Approach* (2014). She has been conferred several awards as represented by "Promising Scientist Award of The Society of Japanese Women Scientists" (1999). She also contributes to the academic advancement as typified by a president of Asian Society for Colloid and Surface Science from 2013. Prof. Imae was an executive member of the Council for Science and Technology Policy in Japan and a member of International Experts Council (IEC) of the Republic of Kazakhstan and she is now a member of the Science Council of Japan.

## Contents

# I. Political activity

### I.1 Political commission

1) 2006~2014 Field advisor of Japan Science and Technology Agency (JST)

2) 2010~2014 Member of National University Cooperation Evaluation Committee in Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan

**3)** 2011/10-present Member of Science Council (CMSC) of Japan

# II. Academic Activity

### II.1 Academic title

1) 2013-2014 Academic Icon Visiting Professor : the Department of Pharmacology, Faculty of Medicine, University of Malaya, Malaysia

2) 2013-2015 Visiting Professor under Research Platform Center Program : Tokyo University of Science, Japan

3) 2015-present Specially-Appointed Professor of iFront Doctoral Program : Graduate School of Science and Engineering, Yamagata University, Japan

### II.2 Academic commission

1) 2004~present Committee member, Asian Society for Colloid and Surface Science

2) 2006~present Life membership of Society of Polymer Science, Japan

3) 2006~present Life member, Chemical Society of Japan

**4)** 2006~present Committee member, Asian Symposium on Advanced Materials

5) 2009~present Committee member, World Federation of Engineering Organization (WFEO) Woman in Engineering and Technology (WiE)

6) 2013-2015 President, Asian Society for Colloid and Surface Science

7) 2014~present Fellow, Japan Oil Chemists' Society, Japan

### II.3 Organizing of international conference

1) 2014 Nov 24-25 The International Conference on Nanocatalysts and Nanomaterials for Green Technologies, Taipei, Taiwan, Co-Chairperson of Organizing Committee (Appendix 1)

2) 2015 July 22-25 International Conference of Colloids and Interface Science 2015, Taipei, Taiwan, Chairperson of Organizing Committee http://jtcc2015.org/ (Appendix 2)

### II.4 International reviewing board of grant

1) Reviewer of research grants of scientific community of Kazakhstan, National Center of Science and Technology Evaluation, Astana, Kazakhstan, 2014

## III. Educational Activity

### III.1 Postdoctoral fellow

1. Dr. Ampornphan Siriviriyanun (2009.10-2014.10) university postdoc, MOST post doc
2. Dr. Bala Murugan (2015.4-present) MOST postdoc, university postdoc
3. Dr. Kinjal Shah (2015.9-present) MOST postdoc
4. Karnthidaporn Wattanakul (2015.12 scheduled) university postdoc

### III.2 PhD course student

1. Kinjal Shah (応用科技研究所) (2012.8.1~2015.7.31) thesis: Applicability of organoclays towards wettability and gas adsorption
2. Mahmoud Mohamed Mahmoud Ahmed (応用科技研究所) (2013.8.1~present)
3. 張家綺 (化学工程系) (2014.8.1~present)
4. Mekuriaw Assefa (応用科技研究所) (2015.2.1~present)

### III.3 Master course student

1. 李聖儒 (化学工程系) (2012.8.1~2014.1.31) thesis: Characteristics of Hybrids of Graphene Oxide and Dendrimer

2. 張家綺 (化学工程系) (2012.8.1~2014.7.31) thesis: Surface Enhanced Raman Scattering of Confeito-like Gold Nanoparticles on Amine-surface Substrates
3. 黃正昌 (化学工程系) (2012.8.1~2014.7.31) thesis: Cascade Fluorescence Resonance Energy Transfer Studies of Pyrene, 3-Acetyl-7-N,N-Diethylcoumarin and Acridine Orange
4. 李安湘 (化学工程系) (2012.8.1~2014.7.31) thesis: Dendrimer-stabilized Single Walled Carbon Nanohorn as Anticancer Drug Carrier
5. Yohan Widjaja (化学工程系) (2012.8.1~2014.7.31) thesis: Producing Versatile Single-Walled Carbon Nanohorns by Covalent Functionalization and Their Application
6. Julius Candrawan (化学工程系) (2012.8.1~2014.7.31) thesis: Selective electrochemical detection of metal ions by porphyrin derivative/graphene derivative thin films on ITO electrode
7. 董妮鑫 (化学工程系) (2012.8.1~2015.1.31) thesis: The synthesis of polypyrrole nanorods and its application to dye-sensitized solar cell
8. 黃偉志 (化学工程系) (2012.8.1~2015.1.31) thesis: Fabrication of zinc oxide nnaoparticles and their application on photo-catalytic degradation
9. 謝蕙蓯 (化学工程系) (2013.8.1~2015.7.31) thesis: Synthesis and characterization of nanoparticles-embedded polystyrene microparticles
10. 劉加毅 (化学工程系) (2013.8.1~2015.7.31) thesis: Decomposition of sick house gas by catalyst embedded in cellulose nanofiber film
11. 許宇萱 (化学工程系) (2013.8.1~2015.7.31) thesis: Synthesis of graphene oxide-based magnetic nano-hybrids toward biomedical applications
12. 郭政諭 (化学工程系) (2014.8.1~present)
13. 蘇進豪 (化学工程系) (2014.8.1~present)
14. Ni'matut Tamimah (応用科技研究所) (2014.8.1~present)
15. Karen Sabrina Asiku (応用科技研究所) (2015.2.1~present)
16. 許 峻嘉 (化学工程系) (2015.8.1~present)
17. 許煜偉 (化学工程系) (2015.8.1~present)

**III.4 Oral examination commission**

1. 国立台湾科技大学応用科技研究所修士口試委員 (2014/1)
2. 国立台湾科技大学応用科技研究所修士口試委員 (2014/7)
3. 国立台湾科技大学化学工程系博士口試委員 (2014/7)
   Paola G. Pittori (supervisor:林析右教授):Evaporation spreading and impact of droplets
4. 国立台湾科技大学化学工程系博士口試委員 (2015/1)
   Addisu Getachew Destaye (supervisor: 李振網教授):Antimicrobial Electrospun Polyvinyl Alcohol (PVA) Nanofibrous Mat with Incorporating Glucose Oxide, Silver Nanoparticles, and H-Halamines Modification
5. 国立台湾科技大学応用科技研究所修士口試委員 (2015/1)
6. 国立台湾科技大学応用科技研究所修士口試委員 (2015/7)
7. 国立台湾科技大学応用科技研究所博士口試委員 (2015/7)

**III.5 Lecture record**

1. 2014/February-June, Advanced Science and Technology 化学工程系
2. 2014/October 20-Nobember 1, Advanced Science and Technology (75 hrs intensive course), THE KAZAKH NATIONAL TECHNICAL UNIVERSITY, Kazakhstan
3. 2015/February-June, Advanced Science and Technology 化学工程系

**III.6 Student's activity**

✧ **Conference**:

1) Annual meeting of Chemical Society of Japan, Asian countries symposium, 3/27-30, 2014, Ampornphan Siriviriyanun and Toyoko Imae, Advanced non-fluorinated coating materials with anti-fingerprint property on solid surfaces (**Invited talk by Ampornphan Siriviriyanun**)

2) 2014 248th ACS National Meeting & Exposition, held at San Francisco, CA, USA, August 10-14, 2014, Shah, K. J.; Shukla, A. D.; Imae, T.; Shah, D. O., Controlled Water and Oil Penetration of Organically Modified Clays by Choice of Cationic Surfactants with Variety of Substituents. (**Poster Presentation by Kinjal Shah**)

3) 2015 International Conference on Nanospace Materials (ICNM), held at National Taiwan University, Taipei, Taiwan, June 23-25, 2015, Shah, K. J.; Shukla, A. D.; Imae, T., Interlayer Swelling and Molecular Packing in Organoclays. (**Poster Presentation by Kinjal Shah**)

4) Nanocatalysis and Nanomaterials for Green Technologies. (ICNNGT) Taipei, Taiwan, Nov. 23-25, 2014, Mahmoud M. M. Ahmed, Masaki Ujihara and Toyoko Imae, Massive exfoliation of Magnetic graphene. (**Poster presentation by M. M. M. Ahmed, Best Poster Award(Gold)**)

5) International Conference of Colloids and Interface Science, Taipei, Taiwan, July 22-24, 2015, Mahmoud M. M. Ahmed, Masaki Ujihara and Toyoko Imae, Production of Magnetic Graphene with Enhanced Electrochemical Properties. (**Poster presentation by M. M. M. Ahmed, Excellent Poster Award**)

6) 66$^{th}$ Annual Meeting of the International Society of Electrochemistry, Taipei, Taiwan, Oct. 04-09, 2015, Mahmoud M. M. Ahmed, Masaki Ujihara and Toyoko Imae, Non destructive exfoliation of magnetic graphene towards energy applications. (**Poster presentation by M. M. M. Ahmed, Student Poster Prize**)

7) 228$^{th}$ The Electrochemical Society (ECS) Meeting, Phoenix, Arizona, USA, Oct. 11-15, 2015, Toyoko Imae, Mahmoud M. M. Ahmed, and Masaki Ujihara, Non destructive exfoliation of magnetic graphene towards energy applications. (**Oral presentation by M. M. M. Ahmed**)

8) 2015 Annual Meeting of the Chinese Colloid and Interface Society, July 21-24 2015, Taipei, Taiwan, Chia-Chi Chang, Toyoko Imae, Liang-Yih Chen and Masaki Ujihara, Surface Enhanced Raman Scattering of Confeito-like Gold Nanoparticles on Amine-surface Substrates (**Poster presentation by Chia-Chi Chang**)

9) 2014 Annual Meeting of the Chinese Colloid and Interface Society, July 11 2014, Tainan, Taiwan, Chia-Chi Chang and Toyoko Imae, Surface Enhanced Raman Scattering of Confeito-like Gold Nanoparticles on Amine-surface Substrates (**Poster presentation by Chia-Chi Chang**)

✧ **Collaboration research:**

1) Oct. 4-Nov. 5, 2015, dispatch for collaboration research at Institut Charles Sadron, France, under MOST PHC ORCHID program with Prof. Marie Pierre Krafft **(by** 張家綺)

✧ **Summer school program:**

1) July 27-August 8 2015, participation in a class at summer school program in Tokushima University **(by Karen Sabrina Asiku)**

✧ **Award: (Appendix 3)**

1) Nov. 24-25, 2014, **Best Poster Award (Gold)** in The International Conference on Nanocatalysts and Nanomaterials for Green Technologies (ICNNGT) Conference, Taipei, Taiwan, **Mahmoud M. M. Ahmed**

2) July 22-24, 2015, **Excellent Poster Award** in (ICCIS) Conference, **Mahmoud M. M. Ahmed**

3) August 7, 2015, **Best Oral Presentation** at summer school 2015 in Tokushima University, **Karen Sabrina Asiku**

4) Oct. 4-9, 2015 **Student Poster Prize** in the 66$^{th}$ Annual Meeting of the International Society of Electrochemistry. **Mahmoud M. M. Ahmed**

## IV Research Activity

### IV.1 Invited lecture

1) May 12, 2014, University of Malaya, Kuala Lumpur, Malaysia, Toyoko Imae, New generation drug delivery systems for therapy

2) May 23, 2014, National Taiwan University, Taipei, Taiwan, Fabrication of Smart Nanomaterials and Their Possible Applications: Carbon, Metal, Mineral and Polymer Materials and Their Composites

3) October 20, 2015, Institut Charles Sadron (CNRS), Strasbourg, France, Toyoko Imae, Investigation of dendrimers and dendrimer/graphene oxide hybrids for therapies

4) November 30, 2015, National Institute for Materials Science (NIMS), Tsukuba, Japan, Toyoko Imae, Carbon materials-based energy and biomedical sciences

### IV.2 Conference (International)

1) International conference on “Innovations in Energy, Polymer and Environmental Sciences”, Maharashtra, India, 2014/1/10-12, Toyoko Imae, Smart Materials for Sensing, Removal and Degradation of Pollutants **(Invited talk)**

~~2)~~ International Workshop on Japan-Taiwan Joint Workshop on Nanospace Materials, Fukuoka, Japan, 2014/03/11-12, Toyoko Imae, Fabrication of Nanospace in Calcium Phosphate Matrices **(Invited talk)**

~~3)~~ International Symposium on Advanced Polymeric Materials, Kuala Lumpur, Malaysia, 2014/05/14-15, Toyoko Imae and Sheng-Ru Lee, Functionalization of Graphene Oxide by Hydrophilic Dendrimer **(Invited talk)**

4) 20th International Symposium on Surfactants in Solution (SIS2014), Coimbra, Portugal, 2014/06/22-27, Toyoko Imae, Kazuki Osawa, Shin-ichi Yusa and Ampornphan Siriviriyanun, Self-assembling of Amphiphilic Block Copolymers with Dendritic Side Chains in Water **(International advisory committee)**

5) Colloids and Nanotechnologies in Industry 2014/10/22-23, Almaty, Kazakhstan, Toyoko Imae, Fabrication of Nanocomposite Materials for Green and Environmental sciences **(Invited talk)**

6) International Conference on Advanced Materials and Nanotechnology, Kathmandu, Nepal, 2014/11/4-6, Toyoko Imae, Catalyst-incorporated Nanocomposite Materials for Green and Environmental sciences **(Keynote talk, International Advisory Board)**

7) 4th International Mini-Workshop, Chiba, Japan, Nov. 15, 2014, Toyoko Imae, Look back to "Principles of Solution and Solubility" to honor the late Prof. K. Shinoda

8) The International Conference on Nanocatalysts and Nanomaterials for Green technologies, Taipei, Taiwan, 2014/11/24-25, Mahmoud Mohamed Mahmoud Ahmed, Masaki Ujihara and Toyoko Imae, Massive Exfoliation of Magnetic Graphene from Acceptor-type GIC **(Chair persons)**

9) The 8th Conference of the Asian Consortium on Computational Materials, Science (ACCMS-8), June 16-18, 2015, Taipei, Taiwan, Toyoko Imae, Roles of Amine and Iron Oxide on Exfoliation of Graphite (**invited talk)**

10) 2015 International Conference on Nanospace Materials, June 23-25, 2015, Taipei, Taiwan, Kinjal J. Shah and Toyoko Imae, Selective capture of $CO_2$ by poly(amido amine) dendrimer-loaded organoclays (**invited talk, committee member)**

11) International Conference of Women in Science, Technology, Engineering and Mathematics (ICWSTEM), June 25-26, 2015, Ulaanbaatar, Mongolia, Toyoko Imae, What is the evolution of science and technology in 21 century toward the progress of our life? (**keynote talk, board member)**

12) International Symposium of Asia Pacific Society for Materials Research (ISAMR), August 16-20, 2015, Sun Moon Lake, Taiwan, Toyoko Imae, Self-assembling of Amphiphilic Block Copolymers with Dendritic Side Chains and Their Drug-carrying Ability (**Invited talk)**

13) 5th Asian Symposium on Advanced Materials: Chemistry, Physics & Biomedicine of Functional and Novel Materials, Busan Korea, November 1-4, 2015, Toyoko Imae,

Advanced Synthesis and Application of Carbon Materials **(Plenary talk, international Advisory Committee)**

14) 6th Asian Conference on Colloid and Interface Science, November 24−27, 2015, Nagasaki, Japan, Toyoko Imae, Drug-carrying Ability of Self-assemblies consisting of Amphiphilic Block Copolymers with Dendritic Side Chains **(invited talk, International Advisory Committee)**

**IV.3 Conference (domestic)**

1) 63rd Annual Meeting of the Society of Polymer Science, Japan, May 28-30, 2014, Nagoya, Japan, Toyoko Imae, Functionality of Dendrimer-immobilized Graphene Oxide

2) 53rd Annual Meeting of Japan Oil Chemists' Society, September 9-11, 2015, Sapporo Japan, Toyoko Imae, 炭素ナノ材料を用いた新規治療薬剤の開発（**invited talk**）

3) 64th Annual Meeting of the Society of Polymer Science, Japan, May 27-29, 2015, Sapporo, Japan, Toyoko Imae, Hybridization and Application of Dendrimer and Inorganic Materials

4) 54th Annual Meeting of Japan Oil Chemists' Society, September 8-10, 2015, Nagoya Japan, Toyoko Imae, Innovation on Oil Chemistry – Smart Science（**Plenary talk)**

**IV.4 International collaboration project for research (with and without grant)**

1) PI (Taiwan): Toyoko Imae, PI (Spain): Conxita Solans and Jordi Esquena, professor, IQNC-CSIC and CIBER-BBN, Spain, (2010-present) without grant.
outcome: 1) Synthesis and Azo Dye Photodegradation Activity of ZrS2-ZnO Nano-composites, Balu Krishnakumar, Toyoko Imae*, Jonathan Miras and Jordi Esquena, Separation and Purification Technology, 132, 281-288 (2014).

2) Synthesis of functional amphiphilic block-copolymers with dendron side chain
PI (Taiwan): Toyoko Imae, PI (Japan): Shin-ichi Yusa, Professor, Hyogo University, Japan, (2010-present) without grant

3) Characterization of clay-polymer hybrids, PI(Taiwan): Toyoko Imae, PI(India): Atindra D. Shukla, professor, Shah-Schulman Center for Surface Science and Nanotechnology, Dharmsinh Desai University, India, (2012-present) without grant

Outcome: 1) Selective capture of $CO_2$ by poly(amido amine) dendrimer-loaded organoclays, Kinjal J. Shah, Atindra D. Shukla, and Toyoko Imae, RSC Advances (2015) 5, 35985-35992.

**4)** The development and evaluation of nano-graphene-oxide-anticancer drug conjugates PI(Taiwan): Toyoko Imae, PI(Malaysia): Lip Yong Chung, professor, and Lik Voon Kiew, Lecturer, University of Malaya, Malaysia, (2013-2016) supported by **High Impact Research Grant (under collaborative research agreement (MOA) between Taiwan Tec and UM)**
Outcome: 1) Preparation of graphene oxide/dendrim er hybrid carriers for delivery of doxorubicin, Ampornphan Siriviriyanun, Marina Popova, Toyoko Imae, Lik Voon Kiew, Chung Yeng Looi, Won Fen Wong, Hong Boon Lee and Lip Yong Chung, Chem. Eng. J. 281, 2015, 771-781.

5) The characterization of carbon-based energy-saving systems, PI(Taiwan): Toyoko Imae, PI(Japan): Yusuke Yamauchi, National Institute for Materials Science (NIMS), Japan (2013-present) without grant

6) Preparation of magnetic hybrids and their thermotherapeutic application, PI(Taiwan): Toyoko Imae, PI(Japan): Takeshi Kobayashi, professor, and Kaname Tsutsumiuchi, professor, Chubu University, Japan, (2014-present) without grant

7) Synthesis and Characterization of Fluorinated graphene-oxides for biomedical applications, PI(Taiwan): Toyoko Imae, PI(France): Marie Pierre Kraft, Professor, Institut Charles Sadron, CNRS, France, (2015-2016) supported by **France-Taiwan Cooperative Research Project under MOST PHC ORCHID program**

**IV.5 International visitor**

1) 2014 3/6 Prof. Tetsu Yonezawa, Hokkaido University, Japan,

2) 2014 7/8 Prof. Tetsu Yonezawa, Hokkaido University, Japan, **seminar**: Chemical Colloidal Processes for Metal Nanoparticles for Fluorescence and Electronics

3) 2014 10/2 Prof. Masahiro Muraoka and other two professors, Osaka Institute of Technology, Japan

4) 2015 1/5 Prof. Raugah Hashim, University of Malaya, Malaysia

5) 2015 1/9 Prof. Araki Masuyama, and Other three professors, Osaka Institute of Technology, Japan

6) 2015 3/9 Prof. Satoshi Nakata, Hiroshima University, Japan, **seminar**: (March 9, 2015) Dynamic self-organization by using self-propelled motors on water

7) 2015 4/22 Prof. Lip Yong Chung and Dr. Lik Voon Kiew, University of Malaya, Malaysia, **seminar**: (April 22, 2015) Early design and development of nano drug carrier for disease treatment: some basic requirements (by Prof. Chung), Nano-sized polymer therapeutics for the treatment of cancer (by Dr. Kiew)

8) 2015 5/15-19 Prof. Marie Pierre Krafft, University of Strasbourg & Institut Charles Sadron (CNRS), France, **seminar**: (May 19, 2015) FLUORINE IN SOFT MATTER SCIENCE

9) 2015 7/21-26 Prof. Vincent Craig, Australia National University, Australia, **seminar**: (July 23, 2015) Nanobubbles in Non Aqueous solutions and in Bulk The curious stability of Nanobubbles extended

10) 2015 9/1 Prof. Masahiro Muraoka and Prof. Sinya Higashimoto, Osaka Institute of Technology, Japan

11) 2015 11/5-10 Prof. Marie Pierre Krafft, University of Strasbourg & Institut Charles Sadron (CNRS), France

**IV.6 Publication (journal)**

1) Massive-Exfoliation of Magnetic Graphene from Acceptor–Type GIC by Long-Chain Alkyl Amine, Masaki Ujihara,* Mahmoud Mohamed Mahmoud Ahmed, Toyoko Imae* and Yusuke Yamauchi, J. Mater. Chem. A, 2 (12), 4244 – 4250 (2014). SCI

2) Chemically modified polyurethane-$SiO_2$/$TiO_2$ hybrid composite film and its reusability for photocatalytic degradation of acid black 1 (AB 1) under UV light, K.P.O. Mahesh; Dong-Hau Kuo; Bo-Rong Huang; Masaki Ujihara; Toyoko Imae, Applied Catalysis A: General, 475 (2014) 235-241 (2014). SCI

3) Anti-fingerprint Properties of Non-fluorinated Organosiloxane Self-Assembled Monolayer-coated Glass Surfaces, Ampornphan Siriviriyanun and Toyoko Imae,* Chemical Engineering Journal. 246C, 254-259 (2014). SCI

4) Synthesis and Azo Dye Photodegradation Activity of ZrS2-ZnO Nano-composites, Balu Krishnakumar, Toyoko Imae*, Jonathan Miras and Jordi Esquena, Separation and Purification Technology, 132, 281-288 (2014). SCI

5) Phototherapeutic Functionality of Biocompatible Graphene Oxide/Dendrimer Hybrids, Ampornphan Siriviriyanun, Toyoko Imae*, Gabriela Calderó and Conxita Solans, Colloids

and Surfaces B: Biointerfaces, 121, 469-473 (2014). SCI

6) pH-dependent loading of Pt nanoparticles protected by dendrimer in calcium phosphate matrices, Yakub Fam, Toyoko Imae,* Jonathan Miras, Maria Martinez, Jordi Esquena, Microporous and Mesoporous Materials, 198, 161-169 (2014). SCI

7) Chemically modified novel PAMAM-ZnO nanocomposite: synthesis, characterization and photocatalytic activity, Balu Krishnakumar and Toyoko Imae,* Applied Catalysis A: General 486, 170-175 (2014). SCI

8) Solvo-affinity Property of Glass Surfaces Modified by Self-Assembled Monolayers of Organic and/or Inorganic Chemicals, Ampornphan Siriviriyanun and Toyoko Imae,* Journal of the Taiwan Institute of Chemical Engineers, 45, 3081-3084 (2014). (invited paper) SCI

9) Surface-Enhanced Infrared Absorption Spectra of Eicosanoic Acid on Confeito-like Au Nanoparticle, Masaki Ujihara, Nhut Minh Dang, Chia-Chi Chang, Toyoko Imae, Journal of the Taiwan Institute of Chemical Engineers, 45 (2014) 3085-3089. (Invited paper) SCI

10) Effect of Au nanorod assemblies on surface-enhanced Raman spectroscopy, Toyoko Imae* and Xiaoming Zhang, Journal of the Taiwan Institute of Chemical Engineers, 45, 3081-3084 (2014). (Invited paper) SCI

11) Fabrication of PtNi Bimetallic Nanoparticles Supported on Multi-Walled Carbon Nanotubes, Walid Daoush and Toyoko Imae, Journal of Experimental Nanoscience, 10, 392-406 (2015). SCI

12) Ag nanoparticle-immobilized cellulose nanofibril firms for environmental conservation, Bendi Ramaraju, Toyoko Imae* and Addisu Getachew Destaye, Applied Catalysis A: General 492, 184-189 (2015). SCI

13) Catalytic oxidation of formaldehyde in water by calcium phosphate-based Pt composites, Yakub Fam and Toyoko Imae,* RSC Advances 5, 15944-15953 (2015). SCI

14) Selective capture of $CO_2$ by poly(amido amine) dendrimer-loaded organoclays, Kinjal J. Shah, Atindra D. Shukla, and Toyoko Imae,* RSC Advances 5, 35985-35992 (2015). SCI

15) Dendrimer-mediated in situ preparation of size-controlled platinum-nickel alloy nanoparticles on carbon nanotubes as electrocatalysts for methanol Oxidation, Adhimoorthy Prasannan and Toyoko Imae,* Journal of Surface Science Technology, 31(1–2), 47–53 (2015). (Invited article for a FESTSCHRIFT in honour of Prof. D.K. Chattoraj on his 85th Birthday) SCI

16) Preparation of graphene oxide/dendrimer hybrid carriers for delivery of doxorubicin, Ampornphan Siriviriyanun, Marina Popova, Toyoko Imae,* Lik Voon Kiew, Chung Yeng Looi, Won Fen Wong, Hong Boon Lee and Lip Yong Chung, Chem. Eng. J., 281, 771-781 (2015). SCI

17) Efficient surface enhanced Raman scattering on confeito-like gold nanoparticles-adsorbed self-assembled monolayers, Chia-Chi Chang, Toyoko Imae*, Liang-Yih Chen* and Masaki Ujihara, Phys. Chem. Chem. Phys, 17, 32328-32334 (2015). SCI

18) Analytical investigation of specific adsorption kinetics of $CO_2$ gas on dendrimer loaded in organoclays, Kinjal Shah and Toyoko Imae,* Chem. Eng. J., 283, 1366-1373 (2016). SCI

**IV.7 Publication (book)**

1) "Skin Bioscience: A Molecular Approach" Ed. By Toyoko Imae, Pan Stanford Publishing Pte. Ltd., October 17, 2014

**IV.8 Publication (book chapter)**

1) Response for External Stimulation on the Skin in "Skin Bioscience: A Molecular Approach" Masaki Ujihara and Toyoko Imae, Ed. B Toyoko Imae, Pan Stanford Publishing Pte. Ltd., October 17, 43-81, 2014

2) Dendrimers, Dendrigrafts and Their Conjugations as Delivery Vectors in Gene Therapy in "a 4th Edition of Gene and Cell Therapy: Therapeutic Mechanisms and Strategies", Ampornphan Siriviriyanun and Toyoko Imae, Taylor Franscis (CRC press) (2014).

3) Development of nonfouling biomaterials in "Encyclopedia of Biocolloid and Biointerfacial Science", Ruey-Yug Tsay and Toyoko Imae, Ed. Hiroyuki Ohshima, John Wiley & Sons (2015).

4) Colloidal Dispersions of Oxidized Nano-Carbons in "Recent Progress in Surface and Colloids Chemistry with Biological Applications", Masaki Ujihara, Toyoko Imae, Ed. Roger M. Leblanc, Am. Chem. Soc., (2015) in press

**IV.9 Patent**

1) 中華民國 專利公報 （**B**）

證書號數：I459965

公告日： 中華民國 103 (2014) 年 11 月 11 日

名　　稱：生物可相容的糖花狀金奈米粒子、其製備方法及其生物醫學應用

BIOCOMPARTIPLE CONFEITO-LIKE GOLD NANOPARTICLES, METHOD FOR MAKING THE SAME, AND THEIR BIOMEDICAL APPLICATIONS

發明 人： 氏原真樹；今榮東洋子

2) United States Patent
Patent No.: US 8,927,658 B2
Date of Patent: Jan. 6, 2015
FLUORESCENT HYBRID OF DENDRIMER AND GRAPHENE OXIDE;
Inventors: Toyoko Imae, Ampornphan Siriviriyanun

3) 中華民國 專利公報 （**B**）

證書號數：I469434

公告日： 中華民國 104 (2015) 年 01 月 11 日

名　　稱：一種製備負載有奈米碳管之電極之方法、以該方法製備之負載有奈米碳管之電極及其應用METHOD FOR MAKING CARBON NANOTUBE-LOADED ELECTRODE,CARBON NANOTUBE-LOADED ELECTRODE MADE BY THE METHOD, AND APPLICATIONS THEREOF

發明 人：Toyoko Imae, Ampornphan Siriviriyanun

4) 中華民國 專利公報 （**B**）

證書號數：I473763

公告日： 中華民國 104 (2015) 年 02 月 21 日

名　　稱：樹枝狀高分子與石墨烯氧化物的螢光混成物

FLUORESCENT HYBRID OF DENDRIMER AND GRAPHENE OXIDE

發明 人：Toyoko Imae, Ampornphan Siriviriyanun

5) United States Patent
Patent No.: US 9,082,526 B2
Date of Patent: Jul. 14, 2015
METHOD FOR MAKING CARBON NANOTUBE-LOADED ELECTRODE, CARBON NANOTUBE-LOADED ELECTRODE MADE BY THE METHOD, AND APPLICATIONS THEREOF
Inventors: Toyoko Imae, Ampornphan Siriviriyanun

6) United States Patent
Patent No.: US 9,206,322 B2
Date of Patent: Dec. 8, 2015
End of Patent: May 29, 2034

NON-FLUORINATED COATING MATERIALS WITH ANTI-FINGERPRINT PROPERTY, AND EVALUATION METHOD THEREOF
Inventors: Toyoko Imae, Ampornphan Siriviriyanun

### IV.10 Research Project Executed

| 計畫名稱 | 計畫內擔任之工作 | 起迄年月 | 補助或委託機構 | 執行情形 | 經費總額 |
|---|---|---|---|---|---|
| 設計碳系材料之奈米結構於綠能行程之研究 | PI | 2015/08/01 -2016/07/31 | 科技部 | 執行中 | 1,128,000 NTD/year |
| The Australian National University Vincent Craig 教授來台訪問 104/07/21-07/26 | PI | 2015/05/27-105/08/30 | 科技部 | 已結案 | 76,875NTD |
| 臺法幽蘭計畫人員交流PPP計畫—全基化化石墨之製備和蛍光特性分析 104-2911-I-011-507 | PI | 2015/01/01 -2016/12/31 | 科技部 | 執行中 | 330,000NTD/year |
| 有機/無機複合紡織品於智慧建材之應用( 有機/無機雜化纖維材料於醫院 | 共同 PI | 2015/01/01 -2015/12/31 | 国立台湾科技大学建築中心頂尖 | 已結案 | 350,000NTD/year |
| 設計碳系材料之奈米結構於綠能行程之研究MOST 103-2221-E-011-154- | PI | 2014/08/01 -2015/07/31 | 科技部 | 已結案 | 1,220,000 NTD/year |
| 有機/無機複合紡織品於智慧建材之應用( 有機/無機雜化纖維材料於醫院 | 共同 PI | 2014/01/01 -2014/12/31 | 国立台湾科技大学建築中心頂尖 | 已結案 | 300,000NTD/year |
| The Development and Evaluation of Nano-Graphene-Oxide- Anti cancer Drug Conjugates (UM.C /625/1/HIR/MOHE/MED/17) | PI | 2013/08/01-2016/07/30 | University of Malaya High Impact Research Grant | 執行中 | RM100,000/3years |
| 発展効能化碳材料及其於綠能行程之応用 | PI | 1013/08/01 -1014/07/31 | 行政院國家科學委員會 | 已結案 | 1,320,000 NTD/year |

## V. Research Report

### V.1 Research target

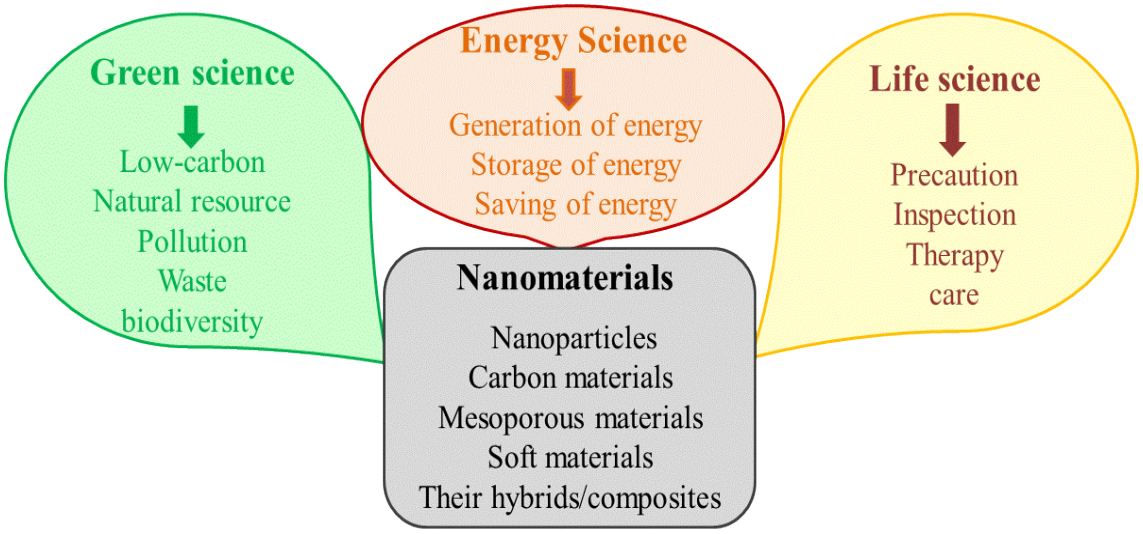
Human being recognizes that the orientation of science in the 21st century should be “science for human”, since the whole world confronts inevitable subjects relating to safe, secure, and healthy human life. On the other hand, in the second half of 20th century, nanotechnology and nanomaterials strikingly developed with deepening of science. Therefore, at present, those are key technology and materials, which overstride all sectional sciences. Thus we focus on the advanced nanotechnology and smart nanomaterials participating in and

finding vent for the “science for human” and have to care for the strong correlation among them at the global view.

Pollutants have adverse effects on human health and environment, and their generation must be prevented, detected and deduced. Especially, $CO_2$ is a typical greenhouse effect gas and a causal agent of global warming. In order to remove pollutant gases including air pollutants ($CO_2$, NOx, and suspended particulate matter), endocrine disruptor (environmental hormone) and toxic gases (ex. dioxins), we must develop the advanced filters, which selectively adsorb pollutant gases. Then the filter may equip with the functionality to self-decompose pollutants, and we can accomplish “the pollutant gas self-treatment membrane”. Sick house/building syndrome is also serious for residents, especially, for children with atopic hypersensitivity. We began the development of the wall materials, which have the functions to decompose sick-house gases (ex. Building material-derived formaldehyde and preservative-derived volatile organic compounds) in “green science”.

In the past years, there is growing interest in renewable energy generations, which are alternative of biofuel and atomic energy. Especially, the development of materials with high efficiency on solar cells and fuel cells is especially growing concern. The hybrid materials, which we have developed so far, are available as materials for such cells, and we targeted our investigation to such directions. To be specific, the hybrids consisting of metal oxide + carbon material or metal oxide + organic sensitizer are valuable to solar cells and the hybrids of Pt-embedded minerals or carbon materials are utilizable for fuel cells in “energy science”.

Lastly we targeted “life science”, because human population is exactly becoming an aging society and in the meanwhile there are many people who are forced unhealthy life in poverty society. In detail, we developed our research in drug delivery systems and photo thermal therapy. Although we partially accomplished such investigation, it was hastened by means of the collaboration with Department of Pharmacology, University of Malaya, Malaysia, and Tokyo University of Science, Japan. We completed, almost, carbon-based drug delivery systems and phototherapy-applicable non-spherical gold nanoparticles.




**V.2 Research project and its achievement**

During two years of 2014 and 2015, we focused three projects.

Project 1. Architecting of advanced systems for pollutant removal and decomposition (*green science*) – Preparation of nanofiber films embedding catalysts and their applications to air pollution degradation -

Project 2. Development of validated systems for energy production and storage (*energy science*) - Designing of architectures composed of carbon materials toward applications in energy production –

Project 3. Fabrication of nanobiotechnological systems for inspection and therapy (*life science*) – Production of graphene-based drug delivery systems and their therapeutic applications –

The investigations for two years can be summarized in the following results.

**1. Green science**: Architecting of advanced systems for pollutant removal and decomposition

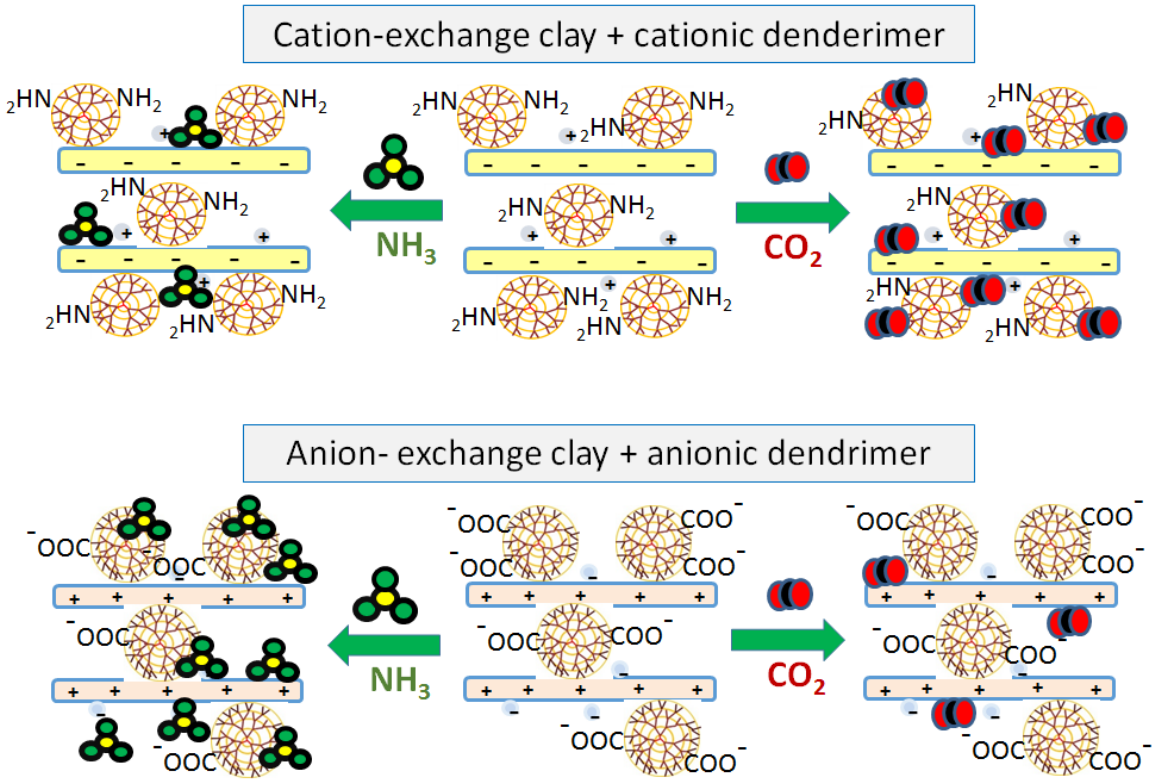
**2. Energy science**: Development of validated systems for energy storage

**3. Life science**: Fabrication of nanobiotechnological systems for medical therapy

**1. Green science (Architecting of advanced systems for pollutant removal and decomposition):**

Dendrimers should be reservoirs of small molecules but their handling is not easy because of their small size. Then, we successfully exchanged the ionic dendrimers in/on ion-exchange clays [1-3]. These hybrid materials could selectively adsorb $CO_2$ and $NH_3$ gases. The selectivity depends on the combination of dendrimer and clay. Cation-exchange clays exchanged by amine-terminated dendrimer selectively can adsorb $CO_2$ and anion-exchange clay exchanged by carboxylate-terminated dendrimer can select the adsorption of $NH_3$.

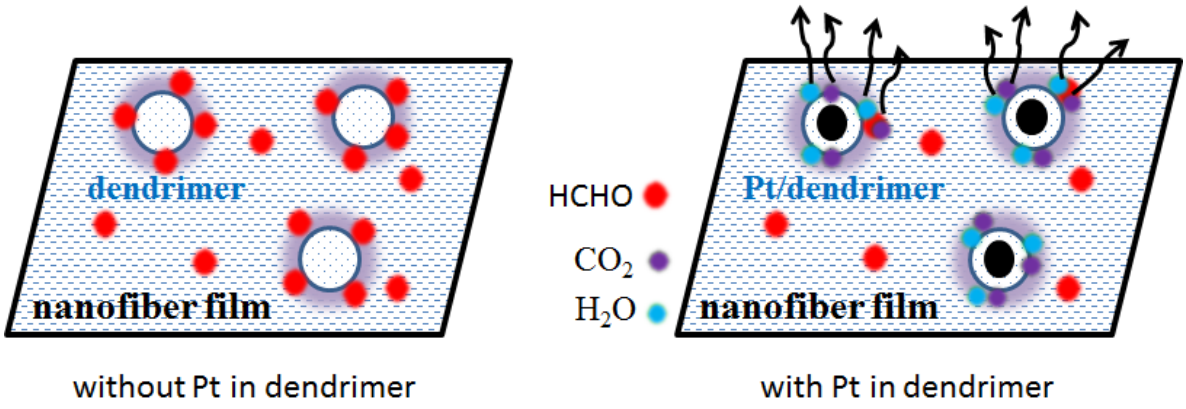
Cellulose nanofibers are products from natural cellulose pulps and these eco-friendly materials can form transparent films rather than textile. As preliminary experiments for the application to textile, we chemically combined dendrimer/clay hybrid materials on the nanofibers and the films prepared from three component composites were applied to the adsorption of $CO_2$ and $NH_3$ gases [3]. The behavior of gas adsorption was similar to it on dendrimer/cray hybrids without nanofibers for the case of cation-exchange clays. However, nanofiber films embedded dendrimer/anion-exchange clay hybrids behaved largest adsorption of both gases $CO_2$ and $NH_3$, although the desorption behavior was different between two gases. These results can be explained from the character of dendrimer/clay hybrids and their embedded situation in nanofibers.




Dendrimers can encapsulate nanoparticles of metal and metal oxides in their interior. When this type of organic/inorganic hybrids is bound on nanofibers, we can prepare films encapsulating functional organic/inorganic hybrids. For the case of cupper metal, the hybrid films could be used for cupper-catalyzing chemical reactions. The hybrid films including Ag nanoparticles were useful for decoloration reaction and as an antibacterial film [4]. Especially, such films were reusable and self-degradable. These procedures were extended to encapsulate Pt catalysts. This research is the extension of our previous investigation, where Pt particle-encapsulated dendrimer was embedded in porous hydroxyapatite particles [5]. These types of organic/inorganic hybrid particles were valuable to decompose formaldehyde in water, as we have reported before [6].

The reaction system described above was applied for the decomposition of formaldehyde gas in air, which is known as sick building syndrome gas [7]. In this time we used cellulose nanofibers as a scaffold of dendrimer-mediated Pt catalyst, because the produced film can be easy handled as an absorbent of gases and to decompose the adsorbed gases. Pt nanoparticles were chemically combined to nanofibers by mediating dendrimer, and hybrid films were prepared. The hybrid films were exposed on formaldehyde vapor and the formaldehyde-adsorbed films were analyzed using spectrophotometry. The analytical results indicated that the formaldehyde was adsorbed on whole area of films but formaldehyde

molecules trapped only in or near Pt-encapsulating dendrimer were catalysis-decomposed. These results indicate that the catalyst-loaded textile will be successfully created even for $CO_2$ decomposition, although this is the subject in the next year.




Relating outcome:

1) Selective capture of $CO_2$ by poly(amido amine) dendrimer-loaded organoclays, Kinjal J. Shah, Atindra D. Shukla, and Toyoko Imae,* RSC Advances 5, 35985-35992 (2015).
2) Analytical investigation of specific adsorption kinetics of $CO_2$ gas on dendrimer loaded in organoclays, Kinjal Shah and Toyoko Imae,* Chem. Eng. J., 283, 1366-1373 (2016).
3) Applicability of organoclays towards wettability and gas adsorption, Kinjal J. Shah, PhD thesis in National Taiwan University of Science and Technology (2015).
4) Ag nanoparticle-immobilized cellulose nanofibril firms for environmental conservation, Bendi Ramaraju, Toyoko Imae* and Addisu Getachew Destaye, Applied Catalysis A: General 492, 184-189 (2015).
5) pH-dependent loading of Pt nanoparticles protected by dendrimer in calcium phosphate matrices, Yakub Fam, Toyoko Imae,* Jonathan Miras, Maria Martinez, Jordi Esquena, Microporous and Mesoporous Materials, 198, 161-169 (2014).
6) Catalytic oxidation of formaldehyde in water by calcium phosphate-based Pt composites, Yakub Fam and Toyoko Imae,* RSC Advances 5, 15944-15953 (2015).
**7)** Decomposition of sick house gas by catalyst embedded in cellulose nanofiber film, MS thesis, 劉加毅, MS thesis in National Taiwan University of Science and Technology (2015).

## 2. Energy science (Development of validated systems for energy storage):

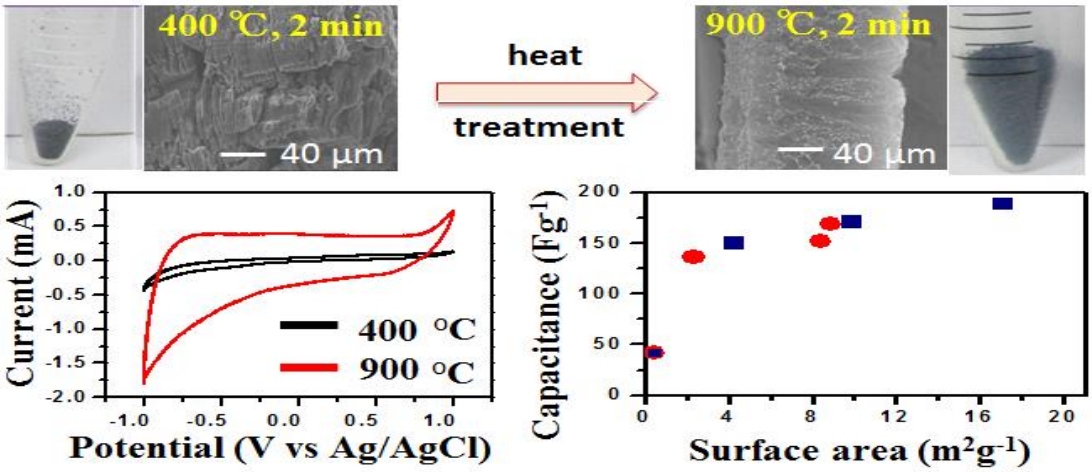
The increasing demand for regenerable energy resources with enhanced energy density encourages the race for finding new devices for energy-production and storage, including solar cells, fuel cells, rechargeable batteries and supercapacitors. Among such devices,

supercapacitors are one of the most talented devices. They exhibit many advantages, including high energy density, fast charge/discharge rate and excellent durability. These features enable supercapacitors to be efficiently used in hybrid electric vehicles and electronic devices. Electrochemical capacitors are classified into two major categories of electric double layer capacitors (EDLC) and pesudocapacitors (PC). The non-faradic process occurring in EDLC is caused by the ion absorption on the active electrode materials at the electrode/electrolyte interface. On the other hand, the faradic process happening in PC is engaged with the redox reactions originated by the charge transfer reactions of metal/metal oxide electrodes. EDLC and PC with various nano-architectures and morphologies have extensively been investigated to achieve high-energy storage and effective capacitance activity.

Carbon-based materials including graphene are unique sources of EDLC due to their unique physical, chemical, electrical and mechanical properties, and conductive polymers or metal oxides are main components of PC owing to their strong electroconductivity. However, the energy density of carbon-based capacitors is not enough high in comparison with PC, and PC is not enough stable at stronger electrochemical conditions. Then the hybrids with different materials including other carbon materials, metal oxides and polymers will provide the preferably appropriate platform for hybrid capacitors. Especially, the conjugation of conductive polymers e.g. polyaniline (PANI), polypyrrole (ppy) and polythiophene with carbon materials can play an crucial role in capacitance enhancement due to the increase in the conductivity and the addition of faradic capacitance to the EDLC. Among different conductive polymers used, PANI has given an exceptional attention due to its mild synthesis procedures. In situ polymerization and electrodeposition are two main methods studied to bind the conductive polymers with graphene oxide (GO) and reduced graphene oxide (rGO), and the implantation of the conductive polymers on the graphenized functional groups is the main way for polymerization. However, GO or rGO provides the defective structure and thus the strong internal resistance drop in the charge and discharge process.

In order to avoid the internal resistance drop, a non-destructive exfoliation and polymerization processes are required. In our previous research, we have successfully prepared the defect-free graphene with remaining iron oxide nanoparticles to exfoliate graphene sheets via a mild amine treatment [1]. Herein, this material was further exfoliated through the thermal procedure, and PANI and ppy were conjugated (hybridized) with the thermally exfoliated, non-defected graphene. The as-prepared graphenes and their hybrids were applied to the investigation of capacitance, one of the important electrochemical parameters on energy storage devices, since this material was expected to be able to achieve the typical supercapacitor behaviour with favourable efficiency. Structural characterizations were performed to scope the optimum condition that provides the excellent capacitance.

Hybrids of graphene (EDLC materials) with electroconductive polymer (PC materials) should become new generation capacitors.




Relating outcome:

1) Massive-Exfoliation of Magnetic Graphene from Acceptor–Type GIC by Long-Chain Alkyl Amine, Masaki Ujihara,* Mahmoud Mohamed Mahmoud Ahmed, Toyoko Imae* and Yusuke Yamauchi, J. Mater. Chem. A, 2 (12), 4244 – 4250 (2014). SCI

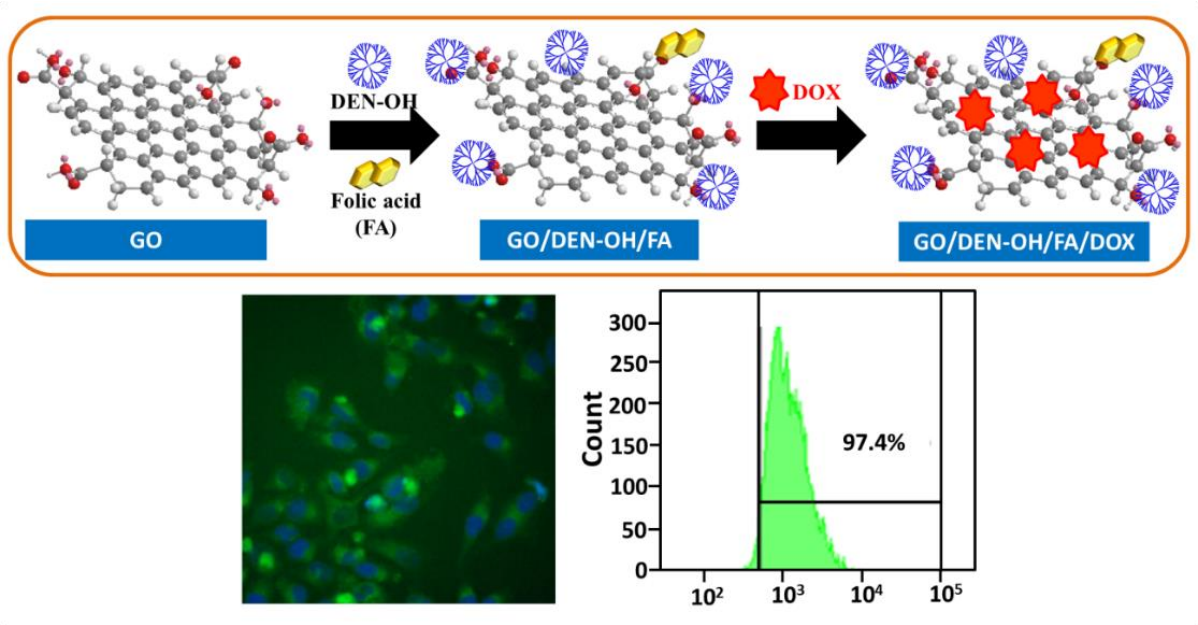
### 3. Life science (Fabrication of nanobiotechnological systems for medical therapy):

Targetable drug nanocarriers have been developed to achieve highly selective delivery of anticancer drugs to tumor cells in a controlled-release fashion. Graphene oxide (GO) is an oxidized graphene composed of a graphitic sheet, which is chemically functionalized with oxygen-including groups such as hydroxyl, carboxyl, carbonyl and epoxide [1]. Due to its biocompatibility, many researchers have focused on the potential of using GO and its derivatives as a promising new material for biomedical applications. In particular, GO has been considered to be a potential carrier for drug delivery system, because the 2D sheet of GO has a large surface area. As a result, drugs can be loaded onto both sides of the graphene sheet through π–π stacking, covalent binding, and hydrophobic or electrostatic interaction. Folic acid (FA)–conjugated nano–GO (FA–nano–GO) has been shown to specifically target human MCF–7 breast cancer cells that express the folate receptor. Furthermore, the successively controlled loading of two anticancer drugs, doxorubicin (DOX) and camptothecin (CPT), onto FA–nano–GO has been achieved via π–π stacking and hydrophobic interactions.

In addition to these properties, the functionalization of GO with biodegradable, biocompatible, nonimmunogenic and water-soluble polymers, such as poly(amido amine)

(PAMAM) dendrimers [2], could further enhance the utility of GO nanohybrid materials as nanocarriers in drug delivery systems. Because low-generation (G1-G4) PAMAM dendrimers can be electrostatically associated with lipid membranes and amphiphilic bilayers, the immobilization of PAMAM dendrimers onto GO may help GO hybrids to bind tightly on cell membranes. In addition, the cellular uptake of dendrimer–based drug delivery systems has been proven to be significantly higher than the linear polymeric carriers, which can be attributed to the nanosize and the compact, spherical geometry of dendrimers. Thus, it is imperative to modify GO with dendrimers to achieve effective drug loading ability and, consequently, efficient drug delivery.

In the present study, the advanced nanocarriers for drug delivery systems were developed by protecting GO with water-soluble PAMAM dendrimers [3,4]. Hydroxyl–terminated PAMAM dendrimers (DEN–OH) were selected, because compounds with amine-terminals are rather toxic. FA was also bound onto GO to target the nanocarriers to specific cells including HeLa cells. Then, in addition to a comparative study of the size dependence of the GO/DEN–OH/FA carriers, the carriers were assessed their ability to load and release doses of DOX and were also evaluated their effects on the viability and the intracellular uptake efficiency by HeLa cells.




Relating outcome:

1) Characteristics of Hybrids of Graphene Oxide and Dendrimer, MS thesis, 李聖儒, MS thesis in National Taiwan University of Science and Technology (2014).

2) Phototherapeutic Functionality of Biocompatible Graphene Oxide/Dendrimer Hybrids, Ampornphan Siriviriyanun, Toyoko Imae*, Gabriela Calderó and Conxita Solans, Colloids

and Surfaces B: Biointerfaces, 121, 469-473 (2014). SCI
3) Preparation of graphene oxide/dendrim er hybrid carriers for delivery of doxorubicin, Ampornphan Siriviriyanun, Marina Popova, Toyoko Imae,* Lik Voon Kiew, Chung Yeng Looi, Won Fen Wong, Hong Boon Lee and Lip Yong Chung, Chem. Eng. J., 281, 771-781 (2015). SCI
4) Synthesis of graphene oxide-based magnetic nano-hybrids toward biomedical applications, MS thesis, 許宇萱, MS thesis in National Taiwan University of Science and Technology (2015).

**4. Additional research subjects besides main three projects:**

✧ **Anti-fingerprint properties of non-fluorinated organosilane self-assembled monolayer-coated glass**

This is the research report based on a fund from Foxlink Co. Ltd., Taiwan, (2011) for developing the reformation of glass surface to impose the anti-finger print character.

Relating output:

1) Anti-fingerprint Properties of Non-fluorinated Organosiloxane Self-Assembled Monolayer-coated Glass Surfaces, Ampornphan Siriviriyanun and Toyoko Imae,* Chemical Engineering Journal. 246C, 254-259 (2014). SCI

2) Solvo-affinity Property of Glass Surfaces Modified by Self-Assembled Monolayers of Organic and/or Inorganic Chemicals, Ampornphan Siriviriyanun and Toyoko Imae,* Journal of the Taiwan Institute of Chemical Engineers, 45, 3081-3084 (2014). (invited paper) SCI

✧ **Surface enhanced spectroscopy by plasmonic gold particles**

This is the report of surface enhanced infrared absorption and Raman scattering investigation of confento-like Au nanoparticles.

Relating output:

1) Surface-Enhanced Infrared Absorption Spectra of Eicosanoic Acid on Confeito-like Au Nanoparticle, Masaki Ujihara, Nhut Minh Dang, Chia-Chi Chang, Toyoko Imae, Journal of the Taiwan Institute of Chemical Engineers, 45 (2014) 3085-3089. (Invited paper) SCI
2) Effect of Au nanorod assemblies on surface-enhanced Raman spectroscopy, Toyoko Imae* and Xiaoming Zhang, Journal of the Taiwan Institute of Chemical Engineers, 45, 3081-3084

(2014). (Invited paper) SCI
3) Efficient surface enhanced Raman scattering on confeito-like gold nanoparticles-adsorbed self-assembled monolayers, Chia-Chi Chang, Toyoko Imae*, Liang-Yih Chen* and Masaki Ujihara, Phys. Chem. Chem. Phys, in press, SCI

4)中華民國 專利公報（**B**）證書號數：I459965 公告日：中華民國 103 (2014)年 11 月 11 日名稱：生物可相容的糖花狀金奈米粒子、其製備方法及其生物醫學應用 BIOCOMPARTIPLE CONFEITO-LIKE GOLD NANOPARTICLES, METHOD FOR MAKING THE SAME, AND THEIR BIOMEDICAL APPLICATIONS 發明人：氏原真樹；今榮東洋子

✧ **Hybrid materials for solar cell and hydrogen cell**

Photocatalytic behavior of metal oxide-based hybrids was investigated.

Relating output:

1) Chemically modified novel PAMAM-ZnO nanocomposite: synthesis, characterization and photocatalytic activity, Balu Krishnakumar and Toyoko Imae,* Applied Catalysis A: General 486, 170-175 (2014). SCI
2) Fabrication of PtNi Bimetallic Nanoparticles Supported on Multi-Walled Carbon Nanotubes, Walid Daoush and Toyoko Imae, Journal of Experimental Nanoscience, 10, 392-406 (2015). SCI
3) Dendrimer-mediated in situ preparation of size-controlled platinum-nickel alloy nanoparticles on carbon nanotubes as electrocatalysts for methanol Oxidation, Adhimoorthy Prasannan and Toyoko Imae,* Journal of Surface Science Technology, 31(1–2), 47–53 (2015). (Invited article for a FESTSCHRIFT in honour of Prof. D.K. Chattoraj on his 85th Birthday) SCI

## VI. Summary

Since three projects were started under sufficient plans and pre-experiments, investigations were rather smoothly performed. The estimated experimental difficulty generated at the step of adsorption/degradation evaluation of pollutant gases in the project 1.

We used conveniently the thermogravimetric analysis instrument for $CO_2$ gas adsorption and prepared a custom-made gas cell for adsorption/degradation of formaldehyde. Since the catalytic efficiency generally depends on surface characteristics of the catalyst systems as well as the amount of the catalysts and temperature, the evaluation of surface characteristics of catalyst systems was done by using a Brunauer–Emmett–Teller (BET) adsorption instrument which was purchased in our laboratory. The evaluation of capacitance in the project 2 was carried out using a photoelectrochemical workstation (a controlled intensity modulated photocurrent spectroscopy (CIMPS)), which we equips. In the project 2, since the biomedical investigation involving cell culture is out of our capability, we needed the collaboration with scientists of medical school. Main three projects and additional research subjects were published in 18 SCI journals within two years as a result of an activity with a staff, postdoctoral fellows, students and collaborators. Especially, it was a great feat for students to gain four awards within recent two years.

Project 1 is based on the project of 國立臺灣科技大學台灣建築科技中心頂尖研究(PI: Prof. Jiunn-Yih Lee; 2014-2016). We are performing this task in consort with other members in this university project and exchanging the data/information for developing a common subject to the cooperative subjects. Project 3 is performed on the basis of Collaborative Research Agreement (MOA) between our university and University of Malaya, Malaysia, which is concluded in 2013. This subject is termed three years (2013/8 – 2016/7) as the first step. In the project, our side is covering the first half of research steps relating to the preparation and characterization of materials, and Malaysian group is handling the last half of research steps concerning to biomedical investigation. We visited each other and kept the communication. Once a student from Malaysian group visited our university to learn the experimental skills and deepen their knowledge. As the ongoing enterprises, the collaboration projects with IQNC-CSIC and CIBER-BBN, Spain, Dharmsinh Desai University, India, University of Hyogo, Japan, and National Institute for Materials Science (NIMS), Japan, are conferred with relevant professors. Additionally, the collaboration research based on the MOU with University of Malaya, Malaysia, is going on smoothly. In this year (2015), we stated new collaboration action with Institut Charles Sadron, France, and Chubu University, Japan.

Separately, I organized “the International Conference on Nanocatalysts and Nanomaterials for Green Technologies” (2014 Nov 24-25, Co-Chairperson of Organizing Committee) and “International Conference of Colloids and Interface Science 2015” (2015 July 22-25, Chairperson of Organizing Committee) in National Taiwan University of Science and Technology, Taipei, Taiwan. Both conferences were supported by Taiwan Electrochemistry Society and Taiwan Colloid an Interface Society, respectively. I also performed my duty as a president of Asian Society of Colloid and surface Science in 6$^{th}$

Asian Conference on Colloid and Interface Science, which was held on November 24−27, 2015, Nagasaki, Japan.

## Acknowledgements

First of all, I express my appreciation to the President Prof. Ching-Jong Liao for his courageous decision on my employment. I also acknowledge Vice-President and Dean of College of Applied Science, Prof. Bernard C. Jiang, who thoroughly supported me for administrating my group. Chairman, Prof. Shanq-Jang Ruan of Graduate Institute of Applied Science and Technology always helped to solve the problems in the Institute. Moreover, I feel grateful for Chairmen, Prof. Jhy-Chern Liu and Prof. Shawn D. Lin of Department of Chemical Engineering, where give me a permission to join as a joint professor. I could always behave like a regular member in the Department of Chemical Engineering and keep a good relation with other professors. Especially, I appreciate the Department for distributing me the students. Ms. Cindy Tseng, an administration assistant, of Graduate Institute of Applies Science and Technology always supported me officially. Prof. Masaki Ujihara helped me for managing our group. I give my thanks for all postdoctoral fellows and students for joining in our group.

I am also grateful to colleagues in and out of National Taiwan University of Science and Technology. I suffered the shared utilization of the laboratory space and instruments from them and I collaborated with them. Especially, we still keep a good relation with Prof. Conxita Solans and Jordi Esquena, Spain, on the research of biomedical materials even after the Taiwan-Spain collaboration (Formosa) program for four years. I also give my thanks for colleagues in India and in Japan, Prof. Atindra D. Shukla, Prof. Shin-ichi Yusa, Dr. Yusuke Yamuchi, Prof. Takeshi Kobayashi and Kaname Tsutsumiuchi for devoted supports on our investigations.

My academic research was financially supported by National Taiwan University of Science and Technology through whole years, and I could set-up our laboratory and instruments by means of this support. International collaboration program was assisted by Ministry of Science and Technology, Taiwan, and we could start the collaboration research with Dr. Marie Pierre Krafft, France, and send a student in her laboratory for a month. Our research was encouraged by the assistance based on 国立台湾科技大学建築中心頂尖計書 (PI: Prof. Jiunn-Yih Lee) and I could expand my research in the environmental science. I also accepted the financial support from University of Malaya, Malaysia, under the collaborative research agreement (MOA) for biomedical activity.

**Appendix 1.**

# 國際奈米觸媒於綠色科技應用研討會 活動企劃書

# The International Conference on Nanocatalysts for Green Technologies

一、 會議目的

能源是現在，也是未來社會發展的關鍵議題。隨著奈米材料科技的進步，相關研究成果也逐漸展現在例如儲能、清淨或再生能源、生醫科技等領域的應用上，如何將國內於前述領域的研究成果進行國際交流，產生更大的學術、產業影響力，同時促進更多的合作與對話，將是本國際會議的重點。

本活動計畫申請成為國際電化學學會(ISE, International Society of Electrochemistry)贊助之學術活動，提升台灣學術國際能見度。

二、 會議子題

(1) 奈米觸媒於綠色能源之應用；
(2) 奈米觸媒於生醫科學之應用；
(3) 奈米材料的合成與特性；
(4) 奈米觸媒反應的基礎研究；

三、 會議日期

103 年 11 月 23-25 日（週日至週二）上午 9 時至下午 5 時

四、 會議地點

國立台灣科技大學國際大樓 101 會議廳
台北市大安區 106 基隆路四段 43 號

五、 會議形式

(1) 專題演講: 針對主題邀請國內外知名學者進行，包括國內 10 位，國際 10 位。講者詳細背景資料如附件二。
(2) 以公開徵求海報(call for posters)方式，提供討論交流平台

六、 預期成效

(1) 鼓勵學術交流，促進學術跨領域合作；
(2) 促進國內產學研界的研究成果進行國際化發表；提升學術影響力；
(3) 鼓勵學生參與國際學術活動；

七、 會議籌備委員

| 姓名 | 職稱 | 服務機關 |
|---|---|---|
| 黃炳照 | 講座教授 | 國立台灣科技大學化工系 |
| | 理事長 | 台灣電化學學會 |
| Toyoko Imae | 榮譽講座教授 | 國立台灣科技大學應用科技研究所 |

| | | |
|---|---|---|
| (今榮東洋子) | | |

## Appendix 2.

### 2015 International Conference of Colloids and Interface Science

**date:** July 22-24, 2015
**venue:** National Taiwan University of Science and Technology (Taiwan Tec)
**room:** IB 101 and 201
**HP:** http://jtcc2015.org/

**Abstraction submission:** June 25, 2015
Extension : July 1, 2015

**Plenary speakers:**
**Prof. Makoto Aratono** (Kyusyu University, Japan)
**Prof. Katsuhiko Ariga** (NIMS, Japan)
**Prof. Vincent Craig** (Australia National University, Australia)
**Prof. Kazue Kurihara** (Tohoku University, Japan)
**Prof. Hsisheng Teng** (National Cheng Kung University, Taiwan)
**Prof. Heng-Kwong Tsao** (National Central University, Taiwan)

**Keynote speakers:**
**Prof. Dong-June Ahn** (Korea University, Korea)
**Prof. Shing Bor Chen** (National University of Singapore, Singapore)
**Prof. Hirofumi Kanoh** (Chiba University, Japan)
**Prof. Yuh-Lang Lee** (National Cheng Kung University, Taiwan)
**Prof. Tsang-Lang Lin** (National Tsing Hua University, Taiwan)
**Prof. Yu-Chen Tsai** (National Chung Hsing University, Taiwan)
**Prof. Tetsu Yonezawa** (Hokkaido University, Japan)

**Special session (free) :**
**(1) Exhibition booth of companies** (7/22-24, IB Lobby A)
**(2) Technical Session by Japanese Enterprise** (7/24, IB201)
**(3) Japanese Tea Ceremony** 日本の茶道 (7/24, IB Lobby A)
**(4) Post conference** (7/25, Chung Shan Medical Univ., Taichung, Taiwan)

http://chemistry1.csmu.edu.tw/ezfiles/33/1033/img/1695/ENG.pdf

**Registration fee:**
General 3,000NTD (2,500NTD by June 25)
Student 1,200NTD (1,000NTD by June 25)
**Application:** http://jtcc2015.org/

**Organizer:** 中華民國界面科學學會&日本化学会
**Chairperson:** Toyoko Imae (NTUST, Taiwan)
**Contact address:** ujihara@jtcc2015.org

### Announcement of special session in ICCIS-2015
### Enterprise Program
*Technical Session by Japanese Enterprise*

Date: July 24, 2015 afternoon
Venue: National Taiwan University of Science and Technology (Taiwan Tec), Taipei, Taiwan
Room: IB 201
Subject: Recent Cosmetics and Detergents R&D in Japan and Introduction of the Companies
Topics for Academic Researchers, Industrial Researchers Marketers, and University and Graduate Students
participation fee: free
Application: through web http://jtcc2015.org/
Contact address: ujihara@jtcc2015.org

**Program**
– Japan Events 12:00-13:30–

**Dr. Kenji IGARASHI**, KOSE Corporation 高絲
"Water in Powder Technology: particle interaction on air-water interface" 13:30-14:00

**Dr. Kei WATANABE**, Shiseido Research Center 資生堂
"α-Gel in Cosmetics - Sodium methyl stearoyl taurate enabled a stable emulsion including salt-type whitening agents -" 14:00-14:30

– Japan Event and Tea Break 14:30-15:00–

**Dr. Masanori ORITA** , Kao Corporation 花王
"Development of α-Gel Containing a Large Amount of Water and the Study of Pseudo-Intercellular Lipid Membrane Formation on a Skin Surface" 15:00:15:30

**Dr. Yukihiro KANEKO**, Lion Corporation 獅王
"Latest Innovation in Heavy Duty Liquid Detergent in Japan/Asia: Spontaneously-generated Solubilization of Oleic Acid by Methyl Ester Ethoxylates (MEE)" 15:30-16:00

– Question Time and Japan Events 16:00-16:30–

*JAPAN EVENTS*
Exhibition booth of companies will be displayed for July 22-24.
"Japanese tea ceremony" will be demonstrated in July 24.

### Announcement of Special Session in ICCIS-2015
### Japanese Culture 日本文化
*Japanese Tea Ceremony 日本茶道*

Date: July 24, 2015

Venue: National Taiwan University of Science and Technology (Taiwan Tec), Taipei, Taiwan
国立台湾科技大学

Room: IB Lobby A 國際大樓一樓展覽會場A區

Hostess 席主: Masako Koyama, Ph.D.
小山宗匡

Title: The Urasenke Chado Tradition
2nd-degree Instructor
茶道裏千家専任講師

Cited from HP of The Urasenke Chado Tradition
http://www.urasenke.or.jp/texte/index.html

## Appendix 3

The International Conference
on Nanocatalysts and Nanomaterials
for Green Technologies

November 24-25, 2014, Taipei, Taiwan

**Best Poster Award(Gold)**

We hereby bestow the award on

**Mahmoud Mohamed Mahmoud Ahmed**

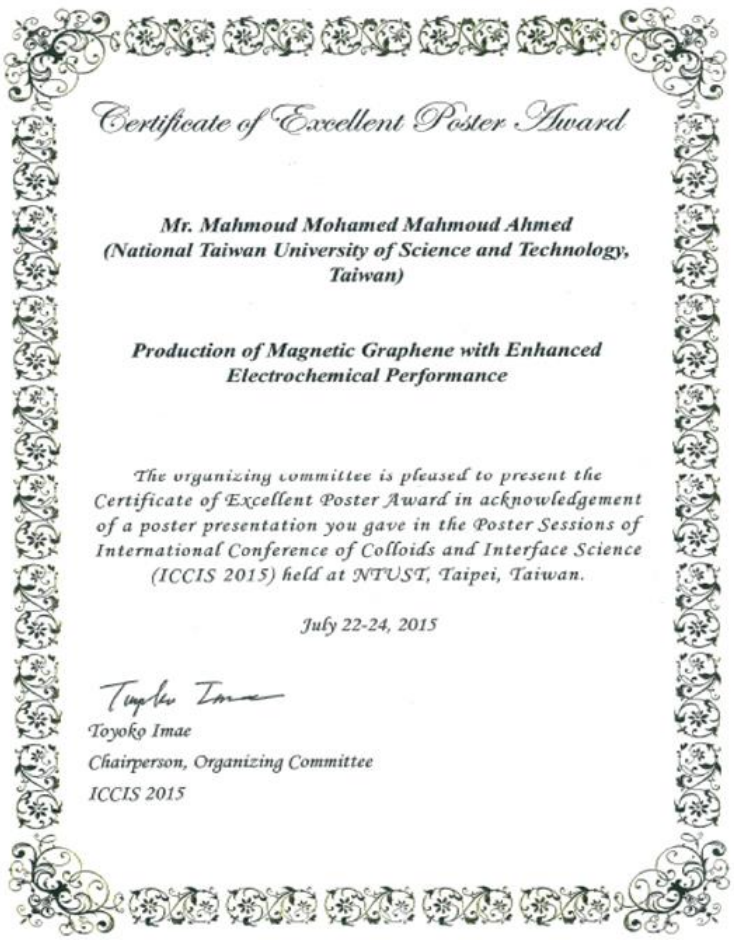
National Taiwan University of Science and Technology, Taiwan

for the poster entitled

"Synthesis and characterization of nano-materials"

Bing-Joe Hwang, Chair Professor
Chair of the ICNNGT

Toyoko Imae, Chair Professor
Chair of the ICNNGT



*Certificate of Excellent Poster Award*

***Mr. Mahmoud Mohamed Mahmoud Ahmed***
***(National Taiwan University of Science and Technology, Taiwan)***

***Production of Magnetic Graphene with Enhanced Electrochemical Performance***

*The organizing committee is pleased to present the Certificate of Excellent Poster Award in acknowledgement of a poster presentation you gave in the Poster Sessions of International Conference of Colloids and Interface Science (ICCIS 2015) held at NTUST, Taipei, Taiwan.*

*July 22-24, 2015*

*Toyoko Imae*
*Chairperson, Organizing Committee*
*ICCIS 2015*


The 66th Annual Meeting of the

International Society of Electrochemistry

Symposium-5 Novel Insights to Electrochemical Capacitors

October 4-9, 2015, Taipei, Taiwan

## Student Poster Prize

We hereby bestow the award on

**Mahmoud Mohamed Mahmoud Ahmed**

NTUST, Taiwan

for the poster entitled

"Nondestructive production of magnetic graphene towards energy applications"

Bing-Joe Hwang, President of the Electrochemical Society of Taiwan