



ACS Nano Summit 2024

THE 22ND INTERNATIONAL NANOTECH
SYMPOSIUM & EXHIBITION

July 3(Wed), 2024
Sungkyunkwan University
Samsung Library Auditorium



PROGRAMME & ABSTRACT BOOK

2DQH
Center for 2D Quantum Heterostructures





Welcome Letter

Dear Colleagues and Participants,

It is a great pleasure to welcome you to the ACS Nano Summit 2024 at SKKU (Department of Energy Science), held on July 3, 2024. The ACS Nano Summit 2024 (SKKU Campus) is intended to provide an interesting forum for students, scientists, and engineers to share the latest breakthroughs and big achievements in nanomaterials & nanotechnology development, physical/chemical characterization with unique properties and functionality.

This symposium features highly impactful presentations by 11 prestigious keynote speakers from ACS Nano editors and 15 invited keynote speakers from SKKU. The goal of ACS Nano Summit 2024 (SKKU Campus) is to identify the key issues related to big ideas in physics, chemistry, materials science, chemical engineering, and biology including the following topics: 1) Bio-Nanotechnology, 2) Nanotechnology I: Energy & Catalyst, 3) Nanotechnology II: Device & Others.

We invite you to join us at the ACS Nano Summit 2024 at SKKU, where you will be sure to have a meaningful experience. SKKU welcomes all the participants for a memorable experience.

Thank you for participating!

Prof. Young Hee Lee

Chairman of the Organizing Committee
Associate Editor, ACS Nano



ACS Nano Summit 2024

THE 22ND INTERNATIONAL NANOTECH SYMPOSIUM & EXHIBITION

July 3(Wed), 2024 Sungkyunkwan University, Samsung Library Auditorium

| Time | Speaker (Chair: ACS Nano Associate Editor, Young Hee Lee SKKU) |
|--|--|
| 10:00 – 10:10 | Opening remarks |
| Session I. Bio-Nanotechnology (Chair: Miso Kim SKKU) | |
| 10:10 – 10:25 | Editor in Chief, Xiaodong Chen NTU |
| 10:25 – 10:40 | Executive Editor, Luis M. Liz-Marzán CIC biomaGUNE |
| 10:40 – 10:55 | Topic Editor, Silvia Marchesan Univ.of Trieste |
| 10:55 – 11:10 | Associate Editor, Tony Hu Tulane Univ. |
| 11:10 – 11:25 | Donghee Son SKKU |
| 11:25 – 11:40 | Inki Kim SKKU |
| 11:40 – 11:55 | Joshua A. Jackman SKKU |
| 11:55 – 12:10 | Sooyeon Cho SKKU |
| 12:10 – 13:30 | Lunch & Poster session |
| Session II. Nanotechnology I : Energy & Catalyst (Chair: Taeyeon Kim SKKU) | |
| 13:30 – 13:45 | Associate Editor, Anita Ho -Baillie Univ. of Sydney |
| 13:45 – 14:00 | Associate Editor, Matthew T. McDowell Georgia Tech. |
| 14:00 – 14:15 | Associate Editor, Jinhua Ye Hebei Univ. |
| 14:15 – 14:30 | Associate Editor, Yan Li Peking Univ. |
| 14:30 – 14:45 | Ki Kang Kim SKKU |
| 14:45 – 15:00 | Jooheon Kang SKKU |
| 15:00 – 15:15 | Miso Kim SKKU |
| 15:15 – 15:30 | IL Jeon SKKU |
| 15:30 – 15:45 | Jung Heon Lee SKKU |
| 15:45 – 16:00 | Coffee break & Poster session |
| Session III. Nanotechnology II : Device & Others (Chair: IL Jeon SKKU) | |
| 16:00 – 16:15 | Executive Editor, Chunying Chen NCNST |
| 16:15 – 16:30 | Associate Editor, Mathieu Salanne Sorbonne Univ. |
| 16:30 – 16:45 | Associate Editor, Wolfgang J. Parak Univ. of Hamburg |
| 16:45 – 17:00 | Hyeon Suk Shin SKKU |
| 17:00 – 17:15 | Boseok Kang SKKU |
| 17:15 – 17:30 | Sungjoo Lee SKKU |
| 17:30 – 17:45 | SeungNam Cha SKKU |
| 17:45 – 18:00 | Changgu Lee SKKU |
| 18:00 – 18:15 | Taeyeon Kim SKKU |
| 18:15 | Poster award ceremony & Dinner |



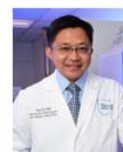
Xiaodong Chen
NTU
Singapore



Luis M. Liz-Marzán
UVigo
Spain



Silvia Marchesan
University of Trieste
Italy



Tony Hu
Tulane University
United States



Donghee Son
SKKU



Inki Kim
SKKU



Joshua A. Jackman
SKKU



Sooyeon Cho
SKKU



Anita Ho-Baillie
University of Sydney
Australia



Matthew T. McDowell
Georgia Tech
United States



Jinhua Ye
Hebei University
China



Yan Li
Peking University
China



Ki Kang Kim
SKKU



Jooheon Kang
SKKU



Miso Kim
SKKU



IL Jeon
SKKU



Jung Heon Lee
SKKU



Chunying Chen
NCNST
China



Mathieu Salanne
Sorbonne University
France



Wolfgang J. Parak
University of Hamburg
Germany



Hyeon Suk Shin
SKKU



Boseok Kang
SKKU



Sungjoo Lee
SKKU



SeungNam Cha
SKKU



Changgu Lee
SKKU



Taeyeon Kim
SKKU



SUNGKYUNKWAN UNIVERSITY



ACS Publications
Most Trusted. Most Cited. Most Read.

ACS Nano Summit 2024

THE 22ND INTERNATIONAL NANOTECH SYMPOSIUM & EXHIBITION

July 3(Wed), 2024 Sungkyunkwan University, Samsung Library Auditorium

| Time | Title | Speaker |
|--|--|---|
| 10:00 – 10:10 | Opening remarks | ACS Nano_Associate Editor, Young Hee Lee SKKU |
| Session I. Bio-Nanotechnology | | Chair: Miso kim SKKU |
| 10:10 – 10:25 | Integrated Plant-electronics Interface | ACS Nano_Editor in Chief, Xiaodong Chen NTU |
| 10:25 – 10:40 | SERS-based Sensing and Imaging in 3D Tumor Models | ACS Nano_Executive Editor, Luis M. Liz-Marzán CIC biomaGUNE |
| 10:40 – 10:55 | Chirality as a Stargate for Peptide Self-assembly into Functional Nanostructures | ACS Nano_Topic Editor, Silvia Marchesan Univ.of Trieste |
| 10:55 – 11:10 | Precision Diagnosis of Tuberculosis: Empowering Personalized Healthcare with Nano and Micro Technologies | ACS Nano_Associate Editor, Tony Hu Tulane Univ. |
| 11:10 – 11:25 | Self-healing, Stretchable, and Tissue-adhesive Materials for Stable Bioelectronics | Donghee Son SKKU |
| 11:25 – 11:40 | Metasurfaces for Biosensing, Molecular Diagnostics, and Biomedical Imaging | Inki Kim SKKU |
| 11:40 – 11:55 | Curvature-sensing Peptide Therapeutics for Biomedical Applications | Joshua A. Jackman SKKU |
| 11:55 – 12:10 | Systematic Design of 3D Corona Phase Interfaces to Accelerate Sensor Development Time | Sooyeon Cho SKKU |
| 12:10 – 13:30 | Lunch & Poster session | |
| Session II. Nanotechnology I : Energy & Catalyst | | Chair: Taeyeon Kim SKKU |
| 13:30 – 13:45 | 2D Perovskite Optoelectronic and Solar Cell Research at the University of Sydney | ACS Nano_Associate Editor, Anita Ho -Baillie Univ. of Sydney |
| 13:45 – 14:00 | Understanding the Evolution of Materials and Interfaces in Solid -State Batteries | ACS Nano_Associate Editor, Matthew T. McDowell Georgia Tech. |
| 14:00 – 14:15 | Solar-to-Fuel Conversion: from Photocatalysis to Photothermal Catalysis | ACS Nano_Associate Editor, Jinhua Ye Hebei Univ. |
| 14:15 – 14:30 | Structure Controlled Synthesis of Single -Walled Carbon Nanotubes | ACS Nano_Associate Editor, Yan Li Peking Univ. |
| 14:30 – 14:45 | Epitaxial Growth of van der Waals Heterostructure on Wafer Scale | Ki Kang Kim SKKU |
| 14:45 – 15:00 | Solution-based Processing of 2D Materials for Scalable Electronics | Jooheon Kang SKKU |
| 15:00 – 15:15 | Electrospinning Piezoelectric Fibers and Yarns for Wearable and Biomedical Self-powered Sensing Applications | Miso Kim SKKU |
| 15:15 – 15:30 | Semiconducting Ratio Modulation of Single -Walled Carbon Nanotubes for Efficient NO ₂ Detection at Low-Temperature | IL Jeon SKKU |
| 15:30 – 15:45 | DNApatite : An Elastic Apatite with Sub -Nanometer Scale Organo-Inorganic Structures | Jung Heon Lee SKKU |
| 15:45 – 16:00 | Coffee break & Poster session | |
| Session III. Nanotechnology II : Device & Others | | Chair: IL Jeon SKKU |
| 16:00 – 16:15 | Exploring the Biological Behavior and Fate of Nanomedicines by Advanced Light Source Analytical Techniques | ACS Nano_Executive Editor, Chunying Chen NCNST |
| 16:15 – 16:30 | Nanostructuring in Highly Concentrated Electrolytes and Its Impact on Electrochemical Devices | ACS Nano_Associate Editor, Mathieu Salanne Sorbonne Univ. |
| 16:30 – 16:45 | Quantitative Interaction of Colloids with Cells | ACS Nano_Associate Editor, Wolfgang J. Parak Univ. of Hamburg |
| 16:45 – 17:00 | Hexagonal and Amorphous Boron Nitride Thin Films | Hyeon Suk Shin SKKU |
| 17:00 – 17:15 | De Novo Synthetic Approaches of π -Electronic Macromolecules for Emerging Electronic Applications | Boseok Kang SKKU |
| 17:15 – 17:30 | Spiking Neural Network Integrated with Impact Ionization Field -effect Transistor Neuron and a Ferroelectric Field-effect Transistor Synapse | Sungjoo Lee SKKU |
| 17:30 – 17:45 | Work Function Engineering of Copper Sulfides for 2D Electronics | SeungNam Cha SKKU |
| 17:45 – 18:00 | Electrical Characterization of van der Waals Ferromagnets | Changgu Lee SKKU |
| 18:00 – 18:15 | Intra Nanogap Effect in Electron Dynamics and Acoustic Vibrations of Au Nanostructures | Taeyeon Kim SKKU |
| 18:15 | Poster award ceremony & Dinner | |

Xiaodong Chen

Professor in Materials Science and Engineering at Nanyang Technological University (NTU), Singapore

Email: chenxd@ntu.edu.sg

Website: <https://personal.ntu.edu.sg/chenxd/>



Xiaodong Chen holds the President's Chair Professorship in Materials Science and Engineering at Nanyang Technological University (NTU), Singapore, with courtesy appointments in both Chemistry and Medicine. His research interests span mechanomaterials science and engineering, flexible electronics technology, sense digitalization, cyber-human interfaces and systems, and carbon-negative technology. Prof. Chen's outstanding scientific contributions have been recognized with numerous awards, including the Singapore President's Science Award, Singapore National Research Foundation (NRF) Investigatorship and NRF Fellowship, the Friedrich Wilhelm Bessel Research Award, Dan Maydan Prize in Nanoscience and Nanotechnology, Winner of Falling Walls, and Kabiller Young Investigator. He is an elected member of the Singapore National Academy of Science, the Academy of Engineering Singapore, and the German National Academy of Sciences Leopoldina, and an elected fellow of the Royal Society of Chemistry, the Chinese Chemical Society, and American Institute for Medical and Biological Engineering (AIMBE). Prof. Chen also serves on the editorial advisory boards of numerous esteemed international journals, including *Advanced Materials*, *Small*, and *Nanoscale Horizons*. Currently, he is the Editor-in-Chief of *ACS Nano*, a flagship journal in nanoscience and nanotechnology.

Integrated Plant-electronics Interface

Xiaodong Chen*

*Innovative Center for Flexible Devices (iFLEX), Max Planck–NTU Joint Lab for Artificial Senses,
School of Materials Science and Engineering, Nanyang Technological University, 50 Nanyang
Avenue, 639798, Singapore.*

**E-mail: chenxd@ntu.edu.sg*

The emerging interdisciplinary field of plant electronics opens a new frontier in understanding and manipulating plant behavior through direct electrical interfacing. This talk will delve into the development of flexible sensors designed to record electrophysiological signals in plants, marking a significant leap towards real-time monitoring and modulation of plant responses. By integrating principles from materials science, plant biology, and electronic engineering, we have fabricated sensors that are not only capable of detecting subtle electrophysiological changes but are also flexible and benign to plant tissues. As one example, we developed a plant-based biohybrid actuator (phytoactuator) that requires no energy conversion, is fast responsive, and accessible by CMOS-based electronics. A plant-conformable electrical interface forms the electrical modulating unit and the plant Venus flytrap forms the actuating unit. Such integrated plant-electronics interface could lead to the development of various plant bioelectronics such as plant robots and plant healthcare devices.

Luis M. Liz-Marzán

Ikerbasque Professor at CIC biomaGUNE, San Sebastián, Spain

Associate Chair at the University of Vigo, Spain

Email: llizmarzan@cicbiomagune.es

Website: <http://personal.cicbiomagune.com/llizmarzan/Luis.html>



Luis M. Liz-Marzán is an Ikerbasque Research Professor at the Center for Cooperative Research in Biomaterials (CIC biomaGUNE) in San Sebastian, Spain. He is also a Group Leader at the Biomedical Networking Center for Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), and holds a part-time Chair in Physical Chemistry at the University of Vigo. His research field of interest is the synthesis, characterization, assembly and (bio)applications of plasmonic nanomaterials.

He received B.S. (1988) and PhD (1992) degrees in Chemistry from the University of Santiago de Compostela. After a 2-year postdoctoral appointment at the Van't Hoff Laboratory (Utrecht University), he started his professional career as an Assistant Professor in the Department of Physical Chemistry at the University of Santiago de Compostela, Spain (1995), but soon moved to the recently created University of Vigo, where he founded the Colloid Chemistry Group and was promoted to full Professor of Physical Chemistry in 2006. In 2012 he was appointed Scientific Director of CIC biomaGUNE, position that he held until end of 2021. He has published more than 550 impactful papers, is a co-inventor on 12 patents and has supervised over 40 PhD students and 60 postdocs, many of whom are professors worldwide (Japan, China, India, New Zealand, Argentina, Brazil, Spain, Germany, France, Portugal, Italy...). He is a member of the Royal Academy of Sciences of Spain, the European Academy of Sciences, and Academia Europaea, and an international member of the National Academy of Engineering (USA). He recently received an Honorary Doctorate from the University of Antwerp (Belgium). He currently serves as an Executive Editor for ACS Nano.

His research has been recognized by many awards, including a Humboldt Research award (2009), Dupont Prize (2010), the inaugural ACS Nano Lectureship award (2012), the Rhodia Prize of the European Colloid and Interface Society (2013), the Medal of the Spanish Royal Society of Chemistry (2014), the Rey Jaime I Prize in Basic Sciences (2015), the Spanish National Research Award on Chemical Science and Technology (2018), the Lilly Foundation Prize on Preclinical Biomedical Research (2021), and recently the Lourenço-Medinaveitia Prize of the Portuguese Society of Chemistry.

SERS-Based Sensing and Imaging in 3D Tumor Models

Luis M. Liz-Marzán*

*CIC biomaGUNE (BRTA), 20014 San Sebastian, Spain
Ikerbasque, 48013 Bilbao, Spain
Cinbio, Universidade de Vigo, 36310 Vigo, Spain*

**E-mail: lizmarzan@cicbiomagune.es*

Nanoplasmonics [1] involves the manipulation of light using materials with significantly smaller sizes than the radiation wavelength. This usually involves nanostructured metals, which very efficiently absorb and scatter light because of their ability to support coherent oscillations of free (conduction) electrons. Therefore, an essential pillar behind the development of nanoplasmonics is the great advance in fabrication methods, which have achieved an exquisite control over the composition and morphology of metal nanoparticles. Colloid chemistry has the advantage of simplicity and large-scale production, with the ability to direct not only nanoparticle morphology but also surface properties and subsequent processing via self-assembly [2,3]. This talk will provide an overview of the fabrication of “nanoplasmonics” building blocks and their integration in materials and devices that can be used for real applications in sensing and diagnostics. In particular, it will focus on the application of nanostructured plasmonic substrates comprising micropatterned Au nanoparticle superlattices and 3D-printed hybrid scaffolds, to the precise SERS detection of selected tumor metabolites which shape the cancer landscape [4,5,6].

References

- [1] L.M. Liz-Marzán, C.J. Murphy, J. Wang, *Chem. Soc. Rev.* **2014**, 43, 3820.
- [2] M. Grzelczak, J. Perez-Juste, P. Mulvaney, L.M. Liz-Marzán, *Chem. Soc. Rev.* **2008**, 37, 1783.
- [3] M. Grzelczak, J. Vermant, E.M. Furst, L.M. Liz-Marzán, *ACS Nano* **2010**, 4, 3591.
- [4] J. E. Lenzi, D. Jimenez de Aberasturi, L.M. Liz-Marzán, *ACS Sensors* **2019**, 4, 1126.
- [5] J. Langer et al., *ACS Nano* **2020**, 14, 28.
- [6] J. Plou, P.S. Valera, I. García, C.D.L. de Albuquerque, A. Carracedo, L.M. Liz-Marzán, *ACS Photonics* **2022**, 9, 333.

Silvia Marchesan

Associate Professor at University of Trieste, Italy

Email: smarchesan@units.it

Website: <https://www.marchesanlab.com>



Silvia Marchesan is Associate Professor at the University of Trieste, Italy. She leads the Superstructures Labs, whose main research activities lie at the interface between supramolecular chemistry and nanotechnology, with a focus on the development of nanostructured materials and composites for various applications, spanning from biomedical uses to catalysis and energy.

She received the PhD in Chemistry from the University of Edinburgh (UK) in 2007. She worked as Honorary Researcher at University College London (UK), as Academy of Finland fellow at the University of Helsinki (Finland), then as CRSS Fellow in a joint position between Australia's national science agency (CSIRO) and Monash University in Melbourne, Australia. In 2013 she moved to Italy to work at the Center of Excellence for Nanostructured Materials at the University of Trieste, where in 2015 she opened the Superstructures Labs thanks to a competitive starting grant. She serves in the editorial board of ACS Nano, and in the advisory board of Chem, ChemComm, J. Mater. Chem. B, Soft Matter, Chem. Eur.J, and ACS Applied Bio Materials. She is member of several international professional societies, including the American Chemical Society, the Materials Research Society, the European Peptide Society, and she is Fellow of the Royal Society of Chemistry, where she serves on the Scientific Committee of the Chemical Biology and Bioorganic Interest Group. She is also member of the Scientific Board of IMDEA Nanoscience (Spain) and of the Italian Peptide Society.

Her research has been recognized by many awards and named lectures, including the Espramer Award by the Italian Peptide Society (2017, Italy), the JSP fellowship for the Buergerstock Stereochemistry Conference (2018, Switzerland), Aulin-Erdtman Lecture (2019, Sweden), the Howard Lecture (2020, UK), the Royal Society of Chemistry Soft Matter Lectureship (2021), and the Career Award by the Proteomass Scientific Society (2024, Portugal). In 2018 she was selected by Nature amongst the top-11 Rising Stars in the natural sciences, and in 2019 by Nature Chemistry amongst the international profiles charting the future of the discipline. In 2018 she was also selected as Italian representative of the Organic Chemistry Division at EuChemS, and in 2020 as EuChemS representative of the division at the ACS national meeting.

Chirality as a stargate for peptide self-assembly into functional nanostructures

Silvia Marchesan*

University of Trieste, Italy

**E-mail: smarchesan@units.it*

Homochirality is Nature's choice for biomolecules (*e.g.*, D-carbohydrates, L-proteins) and functional structures, and we explore new avenues in green nanomaterials based on heterochirality of minimalistic peptides [1]. Non-canonical D-amino acids are strategic to direct molecular conformation towards self-assembly, to increase resistance against enzyme-mediated hydrolysis and fine-tune the lifetime of the nanostructures, whilst boosting bioactivity. Furthermore, short peptides can be produced at low-cost on a large scale whilst having a low molecular weight to avoid immunogenicity.

A milestone in our scientific endeavor was the elucidation of design rules for heterochiral di- and tri-peptides able to form discrete nanotubes of varying diameter and good cytocompatibility, whilst avoiding uncontrolled formation of hierarchical heterogeneous structures [2-3]. Anisotropic nanomaterials bear great potential in terms of applications, including the possibility to directionally guide cell growth for tissue regeneration [4]. Heterochirality can be used also to resolve the inherent tension of conflicting supramolecular instructions provided by the amino acidic components, so that assembly is directed towards different outcomes, such as macroscopic materials, or discrete nanostructures of differing morphology [5]. Other important parameters that direct self-assembly are the pKas of ionizable groups [6], and the conformational landscape visited by the building blocks in solution that drives assembly in different directions, towards crystals or gels [7].

Applications are vast, spanning from the mimicry of enzymes or of the extracellular matrix, to the development of smart antimicrobials or new means of therapy for instance to inhibit amyloid fibrillation or stabilize protein biotherapeutics. New directions currently being explored include the use of these building blocks to attain life-programmable out-of-equilibrium soft matter.

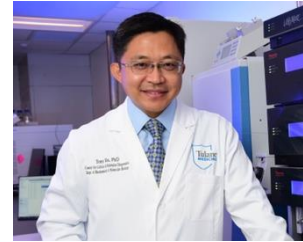
References

- [1] A.M. Garcia *et al.*, *Chem* **2018**, *4*, 1862.
- [2] S. Kralj *et al.*, *ACS Nano* **2020**, *14*, 16951.
- [3] O. Bellotto, *et al. J. Mater. Chem. B* **2023**, *11*, 5378.
- [4] S. Marchesan, *et al. Science* **2017**, *356*, 1010.
- [5] A.M. Garcia *et al.*, *ACS Nano* **2021**, *15*, 3015.
- [6] S. Adorinni *et al.*, *ACS Nano* **2024**, *18*, 3011.
- [7] M. Monti *et al.*, *Chem. Commun.* **2023**, *59*, 10948.

July. 3 (10:55-11:10)

Tony Hu

*Weatherhead Presidential Chair in Biotechnology Innovation
Director, Center for Intelligent Molecular Diagnostics
Professor of Biochemistry and Molecular Biology, Microbiology, and
Biomedical Engineering
School of Medicine, Tulane University
Email: tonyhu@tulane.edu
Website: <https://www.nanodetection.org/>*



Dr. Tony Hu is a Professor in Biochemistry and Molecular Biology, Biomedical Engineering, and Microbiology at Tulane University. He is also the Weatherhead Presidential Chair in Biotechnology Innovation, founding Director of the Center for Intelligent Molecular Diagnostics at Tulane School of Medicine, and the fellows of National Academy of Inventors (NAI) and American Institute of Medical and Biological Engineering (AIMBE).

Dr. Hu's research focuses on engineered multi-omics, nanomedicine, mechanism-driven biomarker discovery and assay development. His research differs from conventional biomarker discovery and detection research for clinical microbiology in that it employs the special properties of nanomaterials to improve assay performance and reproducibility. His inventions are intended to serve as a model for the analysis of similar characteristics of infectious and malignant diseases to facilitate the development of a full spectrum of diagnostic, prognostic and treatment evaluation assays, and re-define the diagnostic criteria to differentiate disease stages using molecular tests as a long-term goal.

His work has resulted in publications of over 150 high-impact papers, and 25 patent applications involving nanomedicine. Fourteen of those patents have been licensed by US-based or international companies. Dr. Hu's lab has been consistently supported by the DOD, NIH, Gates Foundation, WHO and others. He has trained 78 fellows and students from 21 countries, many of whom have moved into independent faculty positions. Dr. Hu is also the co-founders of two biotech startup companies, Intelligenome Inc. in San Jose, CA, ASTRA lifescience in San Diego, CA and NanoPin Technologies in New Orleans, LA.

Precision Diagnosis of Tuberculosis: Empowering Personalized Healthcare with Nano and Micro Technologies

Tony Hu*

J. Bennett Johnston Building Rm 474
333 S. Liberty St, New Orleans, LA 70112
Tel: 504-988-5310

*E-mail: tonyhu@tulane.edu

Precision diagnostic medicine occupies the frontline for the clinical campaign against disease. Historically, Tuberculosis is humanity's leading infectious nemesis, in terms of morbidity/mortality. Today, ~25% of the global population harbors latent *Mycobacterium tuberculosis* (Mtb) infections, with risks for re-activation and spread through close contact. Despite grave impacts, scant research evaluates mechanisms or biomarkers to advance insights into tuberculosis diagnosis, activation, and progression, severely limiting clinical patient management, and perpetuating dire outcomes. Addressing these challenges, my team employs a variety of cutting-edge platforms, including high-resolution mass spectrometry, nanomaterial probes, and CRISPR to elucidate ultrasensitive and quantitative readouts. Translating these advances, we envision simple point-of-care assays, deployed into resource-limited endemic regions, allowing rapid diagnosis and precision guidance for therapeutics, augmenting global pandemic eradication efforts.

References

- [1] Huang, Z., Lyon, C., **Hu, T.** CRISPR-based assays for low-resource settings. *Nature Reviews Bioengineering*. **2023**, 1:230-231.
- [2] Zheng, W., LaCourse, S., Song, B., Singh, D. K., Khanna, M., Olivo, J., Stern, J., Escudero, J., Vergara, C., Zhang, F., Li, S., Wang, S., Cranmer, L.M., Huang, Z., Bojanowski, C.M., Bao, D., Njuguna, I., Xiao, Y., Wamalwa, D. C., Nguyen, D. T., Yang, L., Maleche-Obimbo, E., Nguyen, N., Zhang, L., Phan, H., Fan, J., Ning, B., Li, C., Lyon, C. J., Graviss, E. A., John-Stewart, G., Mitchell, C. D., Ramsay, A. J., Kaushal, D., Liang, R., Pérez-Then, E., **Hu, T.*** Diagnosis of paediatric tuberculosis by optically detecting two virulence factors on extracellular vesicles in blood samples. *Nature Biomedical Engineering*. **2022**. 6, 979-991.
- [3] Huang, Z., LaCourse, S., Kay A., Stern, J., Escudero, J., Youngquist, B., Zheng, W., Vambe, D., Dlamini, M., Mtetwa, G., Cranmer, L., Njuguna, I., Wamalwa, D., Maleche-Obimbo, E., Catanzaro, D., Lyon, C., John-Stewart, G., DiNardo, A., Mandalakas, A., Ning, B., **Hu, T.*** CRISPR Detection of Circulating Cell-free *M. tuberculosis* DNA in Adults and Children, Including Children with HIV. *The Lancet Microbe*. **2022**, 3(7): E482-492.
- [4] Zheng, W., Shu, Q., Mao L., Lyon, C., Li, C., **Hu, T.*** Nanopore-based disease diagnosis using pathogen-derived tryptic peptides from serum. *Nano Today*. **2022**, 45:101515.
- [5] Ning, B., Chandra, S., Rosen, J., Evan, M., Melvin, A., Lane, P., Ivy, T., Brittany, S., Escarra, M., Stacy, D., Zvezdary, K., Lyon, C., Norton, E., **Hu, T.*** Evaluation of pathogen specific T-cell activation with a point-of-care on-chip IGRA. *ACS Nano*. **2022**, Accepted.
- [6] Wang, S., Zheng, W., Zhang, L., Yang, L., Wang, T., Saliba, J., Chandra, S., Chandra, S., Li, C., Lyon, C., **Hu, T.** Monocrystalline labeling enables stable plasmonic enhancement for isolation-free extracellular vesicle analysis. *Small*. **2022**. 2204298.
- [7] Liu, C., Zhao, Z., Fan, J., Lyon, C. J., Wu, H., Nedelkov, D., Zelazny, A.M., Olivier, K.N., Cazares, L.H., Holland, S.H., Graviss, E. A., **Hu, T.*** Quantification of Circulating *M. tuberculosis* Antigens for Rapid Diagnosis and Real-time Treatment Monitoring. *Proc. Natl. Acad. Sci. U.S.A.* **2017**, 114(15):3969-3974. (*Highlighted by New England Journal of Medicine*)

July. 3 (11:10-11:25)

Donghee Son

Associate Professor
Center for Neuroscience Imaging Research (CNIR),
Institute for Basic Science (IBS)
Department of Electronic and Electrical Engineering
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: daniel3600@g.skku.edu
Website: <https://sites.google.com/view/dsonlab/>



Donghee Son is currently an Associate Professor in the Department of Electrical and Computer Engineering at Sungkyunkwan University (SKKU). He received Ph.D. degree in Chemical and Biological Engineering from Seoul National University in 2015. He worked as a postdoctoral fellow in Chemical Engineering at the Stanford University in 2016. He worked as a senior research scientist after moving to Center for Bionics from Korea Institute of Science and Technology (KIST) in 2017. Since he joined the faculty of the Department of Electrical and Computer Engineering at SKKU, he has focused on self-healing stretchable bioelectronics.

Self-healing, Stretchable, and Tissue-adhesive Materials for Stable Bioelectronics

Donghee Son*

*Department of Electrical and Computer Engineering,
Sungkyunkwan University, Suwon 16419 (Republic of Korea)
2Center for Neuroscience Imaging Research,
Institute for Basic Science (IBS), Suwon 16419 (Republic of Korea)*

**Email: daniel3600@g.skku.edu*

Conventional flexible/stretchable devices capable of monitoring bio-signals and delivering the feedback information have been considered as essential functional components in realizing the stable closed-loop bioelectronics. Despite such significant progress, their mechanical and electrical instability, originating from materials fatigue and the absence of tissue adhesion, still remains a challenge in pursuit of strain-durable tissue-interfacing capability. Here, we report optimal stretchable materials design strategies and device fabrication/integration technologies for the two different kinds of self-healing tissue-adhesive bioelectronics: i) A patch-type platform for either facile peripheral nerve repair (neurorrhaphy) in rodents and nonhuman primates or large-scale conformal cardiac interfacing; ii) A syringe-injection-type platform for instantaneous closed-loop rehabilitation. The patch-type self-healing bioelectronics consists of ionically conductive hydrogel adhesive and tough composite electrodes with solid and liquid micro-/nano-fillers, enabling both on-tissue strain-insensitive electrical performance and mechanical adaptation. In terms of the injectable type, tough hydrogel with irreversible yet freely rearrangeable biphenyl bonds and reversible coordinate bonds with conductive gold nanoparticles was applied to injured nerves/muscles for realizing immediate closed-loop robot-assisted rehabilitation and effective tissue regeneration.

References

- [1] D. Seong+, Y. Choi+, I. C. Choi+, J. H. Choi, J. H. Park, J. J. Nam, J. Ju, H. J. Ryoo, D. Kwak, J. Lee, S.-G. Kim, D. H. Kim, J. W. Park*, M. Shin*, and D. Son*, "Sticky and strain-gradient artificial epineurium for sutureless nerve repair in rodents and nonhuman primates", *Adv. Mat.* 2307810, 2024
- [2] H. Choi+, Y. Kim+, S. Kim+, H. Jung, S. Lee, K. Kim, H.-S. Han, J. Y. Kim, M. Shin* and D. Son*, "Adhesive bioelectronics for sutureless epicardial interfacing", *Nat. Electron.* 6, 779-789, 2023
- [3] S. Jin+, H. Choi+, D. Seong+, C.-L. You, J.-S. Kang, S. Rho, W. B. Lee, D. Son* and M. Shin*, "Injectable tissue prosthesis for instantaneous closed-loop rehabilitation", *Nature*, 623, 58-65, 2023.

July. 3 (11:25-11:40)

Inki Kim

Assistant Professor
Department of Biophysics & Institute of Quantum Biophysics
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: inki.kim@skku.edu
Website: <https://www.bionanophotonics-skku.com/>



Inki Kim is an Assistant Professor in the Department of Biophysics, Institute of Quantum Biophysics (IQB) at Sungkyunkwan University (SKKU). He received his Ph.D. degree (with *Chang Kun-Soo* Memorial Award) in Mechanical Engineering at Pohang University of Science and Technology (POSTECH) in 2021, and B.S. degree (with highest honor) in Mechanical Engineering at Ulsan National Institute of Science and Technology (UNIST) in 2015. Prior to joining SKKU in 2021, he was a *Sejong* Science Fellow in Mechanical Engineering at POSTECH. He has published 60+ peer-reviewed articles in journals such as *Nature Nanotechnology*, *Nature Communications*, *Science Advances*, *Advanced Materials*, *Materials Today*, and *Light: Science and Applications*. He is the recipient of several notable honors and awards such as Global Ph.D. Fellowship (2016), SPIE Optics and Photonics Scholarship (2020), MOE Minister's Commendation for the Excellence in BK program (2021), *Chang Kun-Soo* Memorial Award (Best Dissertation in Engineering) (2021), OSA *Robert S. Hilbert* Memorial Student Grant (2021), and OSK Young Optical Scientist Award (2024). Currently his research interests are experimental nanoscale photonics including metamaterials, metasurfaces, plasmonics, nanofabrications, bionanophotonics, quantum biophysics, and quantum-integrated medical devices. His total citation number exceeds over 3,900 with h-index of 36 as of June 2024.

Metasurfaces for biosensing, molecular diagnostics, and biomedical imaging

Inki Kim*

*Department of Biophysics, Sungkyunkwan University, Suwon 16419 (Republic of Korea)
Department of Intelligent Precision Healthcare Convergence, Sungkyunkwan University, Suwon
16419 (Republic of Korea)*

**E-mail: inki.kim@skku.edu*

Metasurface technology provides unique methods to control the light such as enhanced light-matter interactions and wavefront engineering via realizations of nanostructure design of wavelength-scale thickness. Metasurface technology is further not only expanding field of optics and photonics by providing ultra-compact and multifunctional flat optical devices, also resolves challenging problems in diverse sectors like healthcare, optical display, imaging, and military affairs. In this talk, I will introduce metasurface-enhanced multiplexed nanospectroscopy, molecular diagnostics and biomedical imaging technologies. First, we report metasurfaces-driven hyperspectral imaging via multiplexed plasmon resonance energy transfer to probe biological light-matter interactions, which can detect quantum biological electron transfer. Second, we introduce a dielectric metalens device of submicrometer thickness for integrating single molecule on-chip sensors for point-of-care testing. The high numerical aperture, high focusing efficiency, and dual-wavelength operation of the metalens enables the implementation of fluorescence correlation spectroscopy with a single Alexa 647 molecule in the focal volume. Third, we demonstrate a fast metaphotonic PCR device composed of a metamaterial perfect absorber that can rapidly go through thermocycling steps using a single infrared LED for quantitative studies of quantum enzymology. Last, we introduce multimodal biomedical imaging technologies like phase contrast imaging or edge detection for cell and tissue morphology analysis and multifunctional photoacoustic microscope for label free volumetric imaging.

References

- [1] **I. Kim**, H. Kim, S. Han, J. Kim, Y. Kim, S. Eom, A. Barulin, I. Choi, J. Rho and L. P. Lee, *Adv. Mater.*, Vol. 35, No. 32, pp. 2300229, 2023.
- [2] A. Barulin, Y. Kim, D. K. Oh, J. Jang, H. Park, J. Rho and **I. Kim**, *Nat. Commun.*, Vol. 15, No. 26, pp. 1, 2024.
- [3] T. Badloe, Y. Kim, J. Kim, H. Park, A. Barulin, Y. N. Diep, H. Cho, W.-S. Kim, Y.-K. Kim, **I. Kim+** and J. Rho, *ACS Nano*, Vol. 17, No. 15, pp. 14678, 2023.
- [4] A. Barulin, H. Park, B. Park and **I. Kim**, *Photoacoustics*, Vol. 32, pp. 100545, 2023.
- [5] **I. Kim**, H. Kim, M. Go, S. Lee, D. D. Nguyen, S. Kim, G. Cho, J. K. Kim, J. Rho and L. P. Lee, *Advanced Materials* (in revision), 2024

July. 3 (11:40-11:55)

Joshua A. Jackman

*Associate Professor, School of Chemical Engineering
Director, Translational Nanobioscience Research Center
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: jjackman@skku.edu
Website: <https://cheme.skku.edu/jackman-joshua-a/>*



Joshua A. Jackman is an Associate Professor in the School of Chemical Engineering at Sungkyunkwan University (SKKU) in South Korea, where he is also Director of the Translational Nanobioscience Research Center. His group focuses on characterizing the lipid membrane-related interactions of biomacromolecules and nanomaterials with biological systems and translating scientific insights into engineered solutions to address outstanding needs in medicine and biotechnology. Key areas of research include the development of curvature-sensing peptides for antiviral and anticancer applications and antimicrobial lipids for food safety and agricultural applications.

Prof. Jackman has published over 160 papers in top scientific journals such as Nature Materials, Nature Human Behaviour, Nature Protocols, ACS Nano, and the Journal of the American Chemical Society, and has filed over 10 patents, several of which have been licensed commercially. Prof. Jackman's research has led him to receive international scientific honors such as the inaugural BBA Biomembranes Rising Star award and recognition as an ACS Nano Junior Fellow. He has also served on the editorial boards of scientific journals such as ACS Infectious Diseases and BBA Biomembranes. Before starting his faculty career at SKKU, Prof. Jackman was a Postdoctoral Scholar at the Stanford University School of Medicine. He earned his B.S. degree summa cum laude in Chemistry from the University of Florida and undertook Ph.D. studies in Medical Engineering and Medical Physics at the Harvard-MIT Division of Health Sciences and Technology before completing his Ph.D. degree in Materials Science and Engineering from Nanyang Technological University.

Curvature-sensing peptide therapeutics for biomedical applications

Joshua A. Jackman*

School of Chemical Engineering, Sungkyunkwan University, Suwon 16419 (Republic of Korea)

**E-mail: jjackman@skku.edu*

Various biological nanoparticles of medical importance such as membrane-enveloped viruses and cancer exosomes possess lipid bilayer coatings that are necessary for structural integrity and biological function. Targeting this lipid bilayer coating is an attractive strategy to broadly inhibit pathogenic viruses and cancer exosomes, however, it is important to develop a selective strategy [1]. In this presentation, I will present recent progress to develop curvature-sensing peptide therapeutics that can preferentially form pores in high-curvature membranes in order to inhibit small virus particles and exosomes (< 250 nm diameter) while not affecting low-curvature cellular membranes [2]. The biophysical mechanism of curvature-sensitive pore formation leading to membrane disruption will be covered along with *in vivo* application examples involving (1) therapeutic treatment of lethal Zika virus infection in a brain infection model [3] and (2) synergistic cancer immunotherapy to potentiate the treatment response to an immune checkpoint blockade inhibitor [4]. Future opportunities to engineer short peptides with enhanced membrane-curvature selectivity will also be discussed.

References

- [1] B. K. Yoon, W.-Y. Jeon, T. N. Sut, N.-J. Cho, J. A. Jackman, *ACS Nano* vol. 15, no. 1, 125-148 (2021).
- [2] J. A. Jackman, *Biochimica et Biophysica Acta (BBA) – Biomembranes*, vol. 1864, no. 2, 183821 (2022).
- [3] J. A. Jackman, V. V. Costa, S. Park, A. L. C. V. Real, J. H. Park, P. L. Cardozo, A. R. Ferhan, I. G. Olmo, T. P. Moreira, J. L. Bambirra, V. F. Queiroz, C. M. Queiroz-Junior, G. Foureaux, D. G. Souza, F. M. Ribeiro, B. K. Yoon, E. Wynendaele, B. De Spiegeleer, M. M. Teixeira, N.-J. Cho, *Nature Materials* vol. 17, no. 11, 971-977 (2018).
- [4] S. Shin, H. Ko, C. H. Kim, B. K. Yoon, S. Son, J. A. Lee, J. M. Shin, J. Lee, S. H. Song, J. A. Jackman, J. H. Park, *Nature Materials* vol. 22, no. 5, 656-665 (2023).

July. 3 (11:55-12:10)

Sooyeon Cho

*Assistant Professor
School of Chemical Engineering
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: sooyeonc@skku.edu
Website: www.sycholab.com
Twitter: @sycholab*



Sooyeon Cho has been an assistant professor in the School of Chemical Engineering at SKKU since 2022. He received a B.S. and Ph.D. from the Korea Advanced Institute of Science and Technology (KAIST) in Chemical Engineering (2019). Prior to joining SKKU, Prof. Cho was a postdoctoral associate in the Department of Chemical Engineering at the Massachusetts Institute of Technology (MIT) from 2019 to 2022. He was a visiting scholar in the Department of Electrical Engineering and Computer Science at the University of California, Berkeley in 2016.

Prof. Cho was awarded Innovator Under 35 Asia Pacific from MIT Technology Review (TR35) in 2023. He also received a Rising Star in Measurement Science award from the American Chemical Society (ACS) in 2023, a Distinguished Lectureship Award from the Chemical Society of Japan (CSJ) in 2024, a POSCO Science Fellowship from the POSCO Foundation in 2023, Finalist of Postdoctoral Symposium from MIT in 2021, and the Grand Prize in the Lam Research Thesis Award in 2017. He serves as a Young Editorial Board Member of BMEMat (Wiley).

Prof. Cho's work has focused on the development of chemical and biological sensor systems. His team at SKKU aims to tackle the challenges in conventional process analytics, diagnostics, and therapeutics by combining sensor engineering and nanotechnology. Prof. Cho's goal is to develop innovative analytical systems that enhance smart chemical production and promote a healthy society. To fulfill these objectives, his team explores scientific questions about which optoelectronic materials, instrumental interfaces, and AI software can be combined into a powerful sensor system. His team's major research scope covers all elements of a sensor system, including molecular recognition design of nanomaterials, signal transduction modeling, system interfacing, and AI-based data analytics. He has published more than 60 scientific papers in SCI journals, and his total citation number exceeds 4,700 with an H-index of 27 (Google Scholar, June 2024).

Systematic Design of 3D Corona Phase Interfaces to Accelerate Sensor Development Time

Sooyeon Cho*

School of Chemical Engineering, Sungkyunkwan University, Suwon 16419 (Republic of Korea)

**E-mail: sooyeonc@skku.edu*

To address rapidly changing and expanding unknown antigens, it is necessary to develop sensors specific to biomarkers having distinct molecular structures. While typical sensor construct offers selective and sensitive detection, a significant limitation is that the systems are based on a single type of biological receptor including antibody, aptamer, or receptor targeting a user-defined biomarker, rendering them non-effective for detecting new diseases or adapting to antigen mutations with different molecular structures. Thus, there is an immediate need for a high-throughput sensor development technology that can rapidly design and produce sensors responding to totally different or unknown molecular structures, without relying on a synthesis of new biological receptors and their functionalization.

In this talk, we introduce an accelerated design workflow for receptor-free diagnostic sensor that eliminates the need for time-consuming biological receptor design. We have developed label-free sensor constructs based on an artificial antibody concept, utilizing near-infrared (nIR) fluorescent single-walled carbon nanotubes (SWCNTs). We created versatile 3D corona interfaces of SWCNTs formed by non-covalent functionalization with a wide library of PEG-phospholipids. The tailored morphology and size of 3D nanointerfaces between PEG-lipid ligands and SWCNTs enable strong and selective molecular recognition of different types of biomarkers with nIR signal variations. Through automated high-throughput screening and a combination of molecular dynamics and docking computations, we have established a sensor design rule that facilitates the identification of optimal nanosensor constructs for universal target antigens. Selected examples highlight the versatility in creating fluorescent sensors for various pandemic viruses and proteins in human biofluids. The resulting label-free nanosensors have proven their efficacy even in complex biofluids without any sample preparation and on-site diagnostic form factors that we designed, with a non-biological origin construct demonstrating remarkable stability

References

- [1] S. Lee, **S.-Y. Cho*** et al. *To be submitted*
- [2] Y. Lee, **S.-Y. Cho*** et al. *ACS Nano* **2024**, *18*, 13214-13225.
- [3] H. Kang, **S.-Y. Cho*** et al. *ACS Nano* **2022**, *16*, 17210-17219 [

July. 3 (13:30-13:45)

Anita Ho-Baillie

Professor and John Hooke Chair of Nanoscience

The University of Sydney

Email: anita.ho-baillie@sydney.edu.au

Website: <https://www.sydney.edu.au/science/about/our-people/academic-staff/anita-ho-baillie.html>



Anita Ho-Baillie is the John Hooke Chair of Nanoscience at the University of Sydney, an Australian Research Council Future Fellow and an Adjunct Professor at University of New South Wales (UNSW). She completed her Bachelor of Engineering degree on a Co-op scholarship in 2001 and her PhD at UNSW in 2005. Her research interest is to engineer materials and devices at nanoscale for integrating solar cells onto all kinds of surfaces generating clean energy.

She is a highly cited researcher from 2019 to 2023. In 2021, she was an Australian Museum Eureka Prize Finalist and was named the Top Australian Sustainable-Energy Researcher by The Australian Newspaper Annual-Research-Magazine. She won the Royal Society of NSW Warren Prize in 2022 for her pioneering work in the development of next generation solar cells. In 2023, she is a finalist for four categories for the Australian Space Awards. She is a Fellow of the Australian Institute of Physics, the Royal Society of New South Wales and the Royal Society of Chemistry.

She is currently as an Associate Editor for ACS Nano.

2D Perovskite Optoelectronic and Solar Cell Research at the University of Sydney

Anita Ho-Baillie*

*School of Physics, The University of Sydney, Sydney, NSW 2006, Australia
Sydney Nano, The University of Sydney, Sydney, NSW 2006, Australia
Australian Centre for Advanced Photovoltaics (ACAP), School of Photovoltaic and Renewable
Energy Engineering, University of New South Wales*

**E-mail: anita.ho-baillie@sydney.edu.au*

In the past decade, three-dimensional (3D) metal halide perovskites have been extensively researched for the next generation photovoltaic and opto-electronic devices. The recently emerged two-dimensional (2D) perovskites with better stability while retaining the same degree of versatility in terms of opto-electronic properties have opened up even more opportunities for diverse applications [1]. 3D perovskites have a crystal structure with the corner-sharing six-coordinated octahedra. A 2D or a quasi-2D perovskite involves the slicing of the 3D structure along the crystallographic plane resulting in a structure with layers of corner-sharing octahedra, separated by bulky spacer cations. Structures with a single layer of corner-sharing octahedra result in 2D perovskites while structures with multiple layers result in quasi-2D perovskites. The wide range of spacer choices means a large playing field for designing new types of 2D perovskites with difference phases such as the Ruddlesden–Popper (RP) phase; Dion–Jacobson (DJ) phase; or the alternating cations in the interlayer space (ACI) phase, as determined by the space size. I will talk about how we at the University of Sydney study the properties of layered perovskites for various which are then harnessed for optoelectronics and solar cell applications [2-5].

References

- [1] C.-H. Liao, Md A. Mahmud and A. W. Y. Ho-Baillie, *Nanoscale*, 2023, 4219-4235.
- [2] C.-H. Liao, et al, C.-C. Chueh, A. W. Y. Ho-Baillie, *Adv. Mat.*, 2022, 2104782; C.-H. Liao, et al, C.-C. Chueh, A. W. Y. Ho-Baillie, *Adv. Mat.*, 2024, 2312068.
- [3] I. H. Chao, et al, A. W. Y. Ho-Baillie, C. C. Chueh, *Small* 2023, 2207734.
- [4] C.-H. Liao, et al, A. W. Y. Ho-Baillie, Manuscript under revision
- [5] C.-H. Liao, et al, A. W. Y. Ho-Baillie, Manuscript in preparation

July. 3 (13:45-14:00)

Matthew T. McDowell

*Associate Professor and Carter N. Paden,
Jr. Distinguished Chair for Innovation in Materials Science
and Metals Processing
G. W. Woodruff School of Mechanical Engineering,
School of Materials Science and Engineering
Georgia Institute of Technology, Atlanta, GA, USA*

*Email: mattmcdowell@gatech.edu
Website: <https://mtmcdowell.gatech.edu>*



Matthew McDowell is Associate Professor and Carter N. Paden, Jr. Distinguished Chair for Innovation in Materials Science and Metals Processing at Georgia Tech, with appointments in the Woodruff School of Mechanical Engineering and the School of Materials Science and Engineering. His research is focused on understanding and engineering materials for energy storage. He received his Ph.D. from Stanford University in 2013 and was a postdoc at Caltech from 2013 until 2015. He is the Co-Director of the Georgia Tech Advanced Battery Center and an Associate Editor of *ACS Nano*. McDowell has received numerous awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE), Sloan Fellowship, NSF CAREER Award, the ECS Battery Division Early Career Award, and Georgia Tech's Outstanding Achievement in Early Career Research award. For more information, see <https://mtmcdowell.gatech.edu>.

Understanding the Evolution of Materials and Interfaces in Solid-State Batteries

Prof. Matthew T. McDowell*

Associate Professor and Carter N. Paden, Jr. Distinguished Chair for Innovation in Materials Science and Metals Processing

*G. W. Woodruff School of Mechanical Engineering, School of Materials Science and Engineering
Georgia Institute of Technology, Atlanta, GA, USA*

**E-mail: mattmcdowell@gatech.edu*

Solid-state batteries offer the promise of improved energy density and safety compared to lithium-ion batteries, but electro-chemo-mechanical evolution and degradation of materials and interfaces can play an outsized role in limiting their performance. Here, I will present our emerging understanding of the key differences between how electrode materials behave in solid-state batteries compared to in conventional liquid-electrolyte batteries. Lithium metal anodes in solid-state batteries are intrinsically limited by nanoscale void formation during stripping and dendrite growth during plating. Anode-free solid-state batteries, in which there is no initial lithium metal at the anode interface, offer extremely high energy density, but there is a lack of understanding of how their behavior differs from excess-lithium electrodes. Using X-ray tomography, cryo-FIB, and finite-element modeling, we show that anode-free solid-state batteries are intrinsically limited by current concentrations at the end of stripping due to localized lithium depletion. Alloy anodes, another high-capacity anode material option, typically exhibit fast capacity decay in lithium-ion batteries because of excessive solid-electrolyte interphase growth. We show that alloy anodes in solid-state batteries can exhibit improved interfacial stability and enhanced cyclability, and a new design is presented for dense foil alloy anodes that can lower manufacturing costs. Further characterization of alloy anodes reveals the dynamic nature of interfacial fracture during reaction processes. Taken together, these findings show the importance of controlling chemo-mechanics from the nano-to-microscale in solid-state batteries for improved energy storage capabilities.

Jinhua Ye

*Professor and the Director of Research Center for
Solar Driven Carbon Neutrality, Hebei University, China*

Email: jinhua.YE@nims.go.jp

Website: https://www.nims.go.jp/photocatalysis/toppage_en.html



Jinhua Ye received her Ph.D. from the University of Tokyo in 1990. She has worked in National Institute for Materials Science (NIMS), Japan, from 1991 to 2023, as the Director of Photocatalytic Materials Center (2006-2011), Director of Environmental Remediation Materials Unit (2011-2016), and a Principal Investigator at International Center for Materials Nanoarchitectonics (2007-2023). She was also a Professor of Joint Doctoral Program in Graduate School of Chemical Science and Engineering, Hokkaido University, Japan from 2008-2023, and the Director of TJU-NIMS Joint Research Center, Tianjin University, China, from 2011-2021. She is now a full Professor and the Director of “Research Center for Solar Driven Carbon Neutrality” at Hebei University, China. Her research interests focus on the research and development of photofunctional materials and their applications in the fields of environmental remediation and new energy production. She has published more than 650 high impact research papers with over 66,000 total citations (h index: 132). She has been admitted as a Fellow of the Royal Society of Chemistry since 2016, and also selected as 2016, 2018-2023 Highly Cited Researcher (Clarivate Analytics). She is currently serving as the Associate Editors of ACS Nano, and Science Advances (AAAs).

Solar-to-Fuel Conversion: from Photocatalysis to Photothermal Catalysis

Jinhua Ye^{a,b,*}

^aHebei University, China

^bNational Institute for Materials Science (NIMS), Japan

*E-mail: jinhua.ye@hbu.edu.cn; jinhua.ye@nims.go.jp

Solar-driven photocatalysis offers a potential solution to the problems of energy shortage and environmental pollutions, yet the activity is hampered by the kinetically complex and energetically challenging multi-electron reaction [1]. Recent years, photothermal catalysis based on the plasmonic nanomaterials, has become a rapidly developing and exciting research field due to its enormous advantage in solar spectrum utilization [2]. Sunlight, including UV, visible and infrared light can be utilized by plasmonic catalysts not only to induce local heating but also to generate energetic hot carriers for initiating surface catalytic reactions and/or modulating reaction pathways, resulting in synergistically promoted solar-to-fuel conversion efficiencies [3].

This talk will introduce the latest research advances in the field, focusing on our challenges on the scientific and technological possibilities of nano-materials for solar fuel conversion [4-8]. Efforts to explore suitable photoactive materials and to control their surface/interface structure to achieve a synergistic effect of efficient sunlight absorption and high catalytic activity/selectivity will be introduced. Meanwhile, the reactor design as well as energy management of photothermal system are highly demanded towards practical application of photothermal catalysis, especially under the condition of natural sunlight irradiation. The current understanding of key aspects of solar fuel conversion, as well as the crucial issues that should be addressed in future research activities will also be introduced and discussed.

Reference

- [1] H. Tong, J. Ye*, et al., *Adv. Mater.*, **24**, 229 (2012).
- [2] X. Meng, J. Ye*, et al., *Angew. Chem. Int. Ed.* **53**, 11478(2014).|
- [3] S. Luo, H. Song* and J. Ye*, et al., *Chem. Sci.* **12**, 5701 (2021).
- [4] Y. Li, S. Wang*, Y. Hu*, J. Ye*, et al., *Nat. Commun.*, **10**:2359 (2019).
- [5] S. Luo, H. Lin, J. Ye*, et al., *J. Am. Chem. Soc.* **143**, 12145(2021).
- [6] C. Lv, X. Bai, S. Ning, Y. Li*, J. Ye*, et al., *ACS Nano* **17**, 1725 (2023).
- [7] S. Luo, H. Song*, Jinhua Ye* et al., *J. Am. Chem. Soc.*, **145**, 37, 20530(2023).
- [8] Y. Li*, L. Zhang* & J. Ye*, et al., *Nat. Commun.*, **14**:3171 (2023).

July. 3 (14:15-14:30)

Yan Li

*Boya Professor,
Director, Institute of Inorganic Chemistry,
College of Chemistry and Molecular Engineering,
Peking University, Beijing 100871, China
Email: yanli@pku.edu.cn
Website: <https://www.chem.pku.edu.cn/en/faculty/Faculty1/l/86805.htm>*



Yan Li is presently a Boya Professor at College of Chemistry and Molecular Engineering, Peking University, China. She joined the faculty of Chemistry of Peking University in 1995 and was promoted to full professor in 2002. She has held a few visiting positions worldwide, such as visiting associated professor at Duke University (1999-2001) and distinguished visiting professor at The University of Tokyo (2016-2019). She has been working on the synthesis of carbon nanotubes for 25 years. She developed a strategy to realize chirality-specified synthesis of carbon nanotubes, which was listed as the “Top Ten Chemical Research of the Year” by Chemical & Engineering News. She led her team winning the second prize of National Natural Science of China in 2021. She has got many awards and honors such as Chinese Chemical Society Distinguished Scientist, Science and Technology Researcher medal, Famous Teacher of Beijing City on Higher Education, Top Ten Teacher and Top Ten Tutor of Peking University. She has been an associate editor of ACS Nano since 2016. She is also on the advisory or editorial board of a series of journals including Chemical Society Reviews, Materials Horizons, Carbon and Nano Research. She has served as a member of several international academic organizations such as the MRS Award Nomination Committee.

Structure Controlled Synthesis of Single-Walled Carbon Nanotubes

Yan Li*

Beijing National Laboratory for Molecular Science, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China.

**Email: yanli@pku.edu.cn*

Single-walled carbon nanotubes (SWCNTs) present outstanding properties determined by their structures. Therefore, structure-controlled synthesis of SWCNTs is one of the most important research topics in the field. We developed a strategy for the chirality-specified growth of SWCNTs by using a new family of catalysts tungsten based intermetallic compounds. The structure-specified growth of SWCNTs can be achieved by manipulating the template effect of the catalysts together with the optimization of kinetic growth condition. Relying on the statistic study of structures of SWCNTs grown with different catalysts at different conditions and the in-situ study of SWCNTs on catalysts using aberration-corrected environmental transmission electron microscope, we clarified the co-effects of catalysts and growth conditions on the selectivity of SWCNT growth.

Ki Kang Kim

*Ki Kang Kim, Dr., Associate Professor
Young Fellow of Korea Academy of Science and Technology (Y-KAST)
Department of Energy Science,
Sungkyunkwan University.
#86-579 N-Center
Natural Sciences Campus, 2066, Seobu-ro, Jangan-gu,
Suwon-si, Gyeonggi-do, Republic of Korea (16419)
Tel: +82-31-299-6275 (010-7107-3561)
Email: kikangkim@skku.edu or kikangkim@gmail.com
Homepage: <http://nnr.skku.edu/>*



Ki Kang Kim is an Associate Professor in the Department of Energy Science, Sungkyunkwan University (SKKU). He received his Ph.D in Physics from Sungkyunkwan University, Korea (SKKU), under the supervision of Prof. Young Hee Lee. He held a post-doctoral position at SKKU and Massachusetts Institute of Technology, USA for 4 years and as Assistant/Associate Professor at Dongguk University, Korea for 7 years. He is one of the pioneers in the growth of 2D materials. His group in SKKU and collaborators are currently working on developing novel synthesis techniques for diverse 2D materials and their various emerging applications. He has published more than 140 scientific papers in international journals and his total citation number exceeds over 19,000 times with H-index of 54 (Google Scholar, Mar. 2024).

Epitaxial growth of van der Waals heterostructure on wafer scale

Ki Kang Kim*

Department of Energy Science, Sungkyunkwan University, Suwon 16419 (Republic of Korea)

**Email: kikangkim@skku.edu*

Van der Waals layered materials are renowned for their distinctive physical and chemical properties, characterized by robust spin-orbit coupling, substantial Coulomb interaction, and remarkable magnetoresistance. When vertically stacked, these materials manifest emergent properties that pave the way for fabricating innovative functional devices in fields such as twistronics and spintronics. However, the development of a robust growth platform for vertical heterostructures remains a challenge. In this presentation, I introduce a heteroepitaxial and homoepitaxial growth platform for vertical heterostructures, encompassing combinations such as MoS₂/WS₂, MoSe₂/WSe₂, and MoS₂/MoS₂/WS₂, utilizing chemical vapor deposition [1]. The epitaxial growth of the overlayer on the bottom layer was confirmed via transmission electron microscopy. The resulting vertical heterostructures exhibit stacking orders of AA', AA, and AB. Additionally, I will discuss some applications of these heterostructures, showcasing their potential in advancing current technology.

Reference

[1] J. Lee, S. J. Yun, S. H. Choi, and K. K. Kim et al., in preparation (2024).

July. 3 (14:45-15:00)

Joohoon Kang

*Assistant Professor
School of Advanced Materials Science and Engineering;
KIST-SKKU Carbon Neutral Research Center
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
E-mail: Joohoon@skku.edu
WWW: <http://mfmp.skku.edu>, <http://meas.skku.edu>*



Joohoon Kang is an Assistant Professor in the School of Advanced Materials Science and Engineering and the KIST-SKKU Carbon Neutral Research Center at Sungkyunkwan University (SKKU). He received his B.S. and M.S. degrees in materials science and engineering from Yonsei University in Korea in 2009 and 2011, respectively, and his Ph.D. degree in materials science and engineering from Northwestern University in 2018. He then moved to the University of California at Berkeley as a postdoctoral fellow in the College of Chemistry. His research interests include synthesis, processing, and (opto)electronic applications of nanomaterials

Solution-based processing of 2D materials for scalable electronics

*Joohoon Kang**

School of Advanced Materials Science and Engineering, Sungkyunkwan University, Suwon 16419, Korea

**E-mail: Joohoon@skku.edu*

Two-dimensional (2D) nanomaterials have been received a great attention as potential building blocks for use in fundamental elements of (opto)electronic applications due to their diverse and remarkable electronic and optical properties. However, such fundamental demonstrations cannot be directly applied to practical applications because of scalable synthesis of high-quality nanomaterials and their proper assembly. In this presentation, I will demonstrate wafer-scale van der Waals assembly of 2D materials, which are exfoliated via a molecular intercalation-assisted electrochemical exfoliation method. The resulting materials with distinct electronic properties including metal, semiconductor, and insulator, can be assembled into various (opto)electronic devices such as transistors, diodes, logic gates, and photodetectors. Also, such solution-based approach further enables inkjet printing-based device fabrications without a conventional lithography.

References

- [1] J. Kim, et al., *Adv. Mater.* 34(12), 2106110 (2022).
- [2] Y. Kwon, et al., *Nat. Electron.* 6, 443 (2023).
- [3] J. Kim, et al., *Nano Lett.* 22 (2), 570 (2022).
- [4] J. O. Song, et al., *npj 2D Mater. Appl.* 6 (1), 64 (2022).
- [5] Y. Jeon, et al., *npj 2D Mater. Appl.* 6 (1), 82 (2022).

July. 3 (15:00-15:15)

Miso Kim

*Assistant Professor
Department of Materials Science and Engineering
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: smilekim@skku.edu
Website: <https://smilelab.skku.edu>*



Miso Kim is an assistant professor at the School of Advanced Materials Science and Engineering at Sungkyunkwan University (SKKU). She received her B.S. in Materials Science and Engineering from Seoul National University, South Korea (2004), her M.S. (2007) and Ph.D. degrees (2012) in Materials Science and Engineering from the Massachusetts Institute of Technology. She worked as a senior research scientist at the Korea Research Institute of Standards and Science from 2012 till Feb. 2021. She joined the SKKU in February 2021 as a faculty member. Her primary research interests cover piezoelectric materials and mechanical metamaterials for energy harvesting and sensing.

Electrospinning piezoelectric fibers and yarns for wearable and biomedical self-powered sensing applications

Miso Kim*

*Department of Materials Science and Engineering, Sungkyunkwan University, Suwon 16419
(Republic of Korea).*

**Email: smilekim@skku.edu*

Piezoelectric fibers and fabrics can convert mechanical energy captured from the body into electrical energy with a high signal-to-noise ratio, thus providing self-powered sensing solutions. Unfortunately, achieving shape-adaptive and high-performance piezoelectric polymer fibers remains a significant challenge. Although piezoelectric polymer materials have superior mechanical flexibility than piezoelectric ceramic materials with a mechanically brittle nature, they suffer from relatively low piezoelectric coefficients compared to their inorganic counterparts. On the other hand, structurally, piezoelectric yarns transformed from electrospun fiber mats via twisting offer suitable forms by allowing easy weaving and integration into conventional fabrics for practical applications. Moreover, these yarns can exhibit enhanced mechanical characteristics such as strength, toughness, and failure strain, which are critically required for wearable applications with repeated usage or in harsh conditions, such as during sports. However, few studies exist on piezoelectric yarns compared to the electrospun fiber mats. In this talk, I will discuss our recent advancements in enhancing the piezoelectric and mechanical properties of electrospun piezoelectric fibers, yarns, and coils. Our work spans material doping strategies to structural modifications through yarn twisting, tailored for wearable and biomedical applications (Kim et al, 2023). Additionally, I will highlight the integration of machine learning techniques to enhance the functionality and performance of piezoelectric yarns and coils. Specifically, I will discuss our efforts in classifying body signals captured by piezoelectric yarn devices and optimizing the mechanical properties of reinforced piezoelectric yarns using advanced machine learning algorithms. Through these methodologies, we aim to propel the development of next-generation wearable technologies with enhanced performance and functionality.

Reference

[1] Kim, D., Yang, Z., Cho, J., Park, D., Kim, D. H., Lee, J., ... & Kim, M. (2023) EcoMat, 5 (8), e12384.

July. 3 (15:15-15:30)

IL Jeon

*Associate Professor
Department of Nano Engineering
SKKU Advanced Institute of Nano Technology (SAINT)
Sungkyunkwan University (SKKU)
Suwon 16419, Korea*



*Vice Provost (Associate Vice President)
Offices of International Relations and International Student Services
SKKU International Affairs Division (IAD)*

*Editor-in-Chief of International Journal of Chemical Kinetics
Associate Editor of Battery Energy*

CEO and Founder of JLabNT co ltd

*Email: il.jeon@spc.oxon.org
Website: <https://www.jeonlab.com>*

IL Jeon read Chemistry for Bachelors and Masters degrees at Oxford University, UK. Upon graduation in 2008, he worked as the youngest senior researcher at LG Display Co. Ltd., South Korea for 5 years. In 2016, he received a Ph.D. degree in Chemistry with honours from the University of Tokyo, Japan. After working as a JSPS post-doctoral fellow, he worked as an Assistant Professor and a Lecturer at the same university. He later joined Sungkyunkwan University (SKKU) as an Associate Professor in the Department of Nano Engineering and SKKU Advanced Institute of NanoTechnology (SAINT). Currently, he serves as the Vice Provost for International Affairs at SKKU, while holding an Early-Tenured Professorship. His team are working on nanomaterials, namely, nanocarbon and biomaterials for various device applications ranging from energy (solar cells & batteries) to neuromorphic sensor applications. Additionally, he is the founder and CEO of JLabNT Co. Ltd. and has, thus far, published more than 100 lead-authored SCI papers, and registered more than 8 international & 20 domestic patents

Semiconducting Ratio Modulation of Single-Walled Carbon Nanotubes for Efficient NO₂ Detection at Low-Temperature

Sihyeok Kim¹, Peng Liu², Jin-Myung Choi¹, Jeong-Seok Nam¹, Jang Woo Lee¹, Keekeun Lee^{3,}, Esko I. Kauppinen^{2,*}, IL Jeon^{1,*}*

¹ Department of Applied Physics, School of Science Aalto University, Aalto 15100, Finland

² Department of Nano Engineering, Department of Nano Science and Technology, SKKU Advanced Institute of Nanotechnology (SAINT), Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea

³ Department of Electrical and Computer Engineering, Ajou University, Suwon, Gyeonggi-do, 16499, Republic of Korea

*Email: il.jeon@spc.oxon.org

This study presents a nitrogen dioxide (NO₂) gas sensor based on single-walled carbon nanotubes (SWCNTs) with varying proportions of semiconducting SWCNTs (s-SWCNTs). The SWCNTs were synthesised using a floating catalyst chemical vapor deposition (FCCVD) method. The purity of the s-SWCNTs was controlled by adjusting the carbon source, reactor temperature, and gas flow rates. The FCCVD-synthesised CNT thin films can be transferred via a simple one-step process without the need for solvents, a significant advantage over conventional CNTs. As reported in our previous publication [1], sensors utilising FCCVD CNTs demonstrate superior performance in sensitivity, response time, and detection limit among CNT-based NO₂ sensors. Additionally, the optimal operating temperature for these sensors was found to be 150 °C, significantly lower than that of metal oxide-based NO₂ sensors, which typically operate around 400 °C.

In this work, we further improved the sensing performance and reduced the optimal operating temperature by controlling the ratio of s-SWCNTs. A higher proportion of semiconducting content increased the binding energy between the gas molecules and the CNT surface, significantly enhancing the sensor performance, even at lower temperatures of 120 °C. A sensor with 94% s-SWCNT exhibited an exceptionally high response (83.2% at 500 ppb) and a fast response time (~8.6 s) compared to previously reported studies [2,3]. Conversely, a sample with 87% s-SWCNT demonstrated an extremely rapid recovery (72.8 s). Additionally, the proposed sensor showed superior selectivity compared to other gases and maintained stable properties for up to 6 months. These experimental and theoretical findings suggest that efficient control of s-SWCNT content can pave the way for innovative approaches in various sensor applications in the near future.

Reference

[1] S. Kim, et al., *Adv. Mater.*, (2024) 2313830.

[2] M. Jeon, et al., *Appl. Phys. Lett.*, (2017), 022102.

[3] L. Sacco, et al., *Carbon*, (2020), 631.

Corresponding Author: I. Jeon

Jung Heon Lee

*Professor
School of Advanced Materials Science and Engineering
Department of MetaBioHealth
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: jhlee7@skku.edu
Website: <https://bionano.skku.edu>*



Jung Heon Lee is a Full Professor at Sungkyunkwan University (SKKU), Korea. He earned his B.S. in Metallurgical Engineering from Yonsei University, an M.S. in Materials Science and Engineering from Seoul National University, and a Ph.D. in Materials Science and Engineering from the University of Illinois at Urbana-Champaign. After completing his post-doctoral training at Northwestern University, he joined the School of Advanced Materials Science and Engineering at SKKU as a faculty member in 2012. He is also affiliated with the Department of MetaBioHealth, the Biomedical Institute for Convergence at SKKU (BICS), the Institute of Quantum Biophysics (IQB), and the Research Center for Advanced Materials Technology at SKKU.

Prof. Lee leads the Biological and Nanoscale Materials Laboratory at SKKU, focusing on developing nanoscale materials and devices for diagnostic and therapeutic applications in biological systems. His research explores the adaptation of the programmable and modifiable properties of biomolecules for the fabrication of smart materials and advanced nanoscale devices. Prof. Lee has published over 120 research articles in prestigious peer-reviewed international journals, including ACS Nano, Journal of the American Chemical Society, Nano Letters, Advanced Materials, Advanced Science, Angewandte Chemie International Edition, Small, Science Advances, etc. Additionally, he has filed 60 patents, including 7 U.S. patents, with 40 patents granted.

DNAPatite: An Elastic Apatite with Sub-Nanometer Scale Organo–Inorganic Structures

Jung Heon Lee*

*School of Advanced Materials Science & Engineering, Sungkyunkwan University, Suwon 16419
(Republic of Korea)*

**Email: jhlee7@skku.edu*

Hydroxyapatite (HA) is renowned for its exceptional biocompatibility, bioactivity, osteoconductivity, and inherent anti-inflammatory properties. Despite extensive research into pure HA, ion-doped HA, and HA-polymer composites, significant challenges such as brittleness persist. In this study, we introduce a new approach to synthesize deoxyribonucleic acid apatite (DNAPatite) through the self-crystallization of polymeric single-stranded deoxyribonucleic acid (ssDNA) without the need for additional phosphate ions. The resulting DNAPatite, with the composition $\text{DNA1Ca2.2(P04)1.3OH2.1}$, exhibits a unique dual-phase structure comprising inorganic HA crystals and amorphous organic ssDNA at the sub-nanometer scale, organized into nanorods. This novel material demonstrates markedly improved mechanical properties, including enhanced toughness and elasticity, and a Young's modulus comparable to that of natural bone. These advancements position DNAPatite as a promising candidate for advanced biomedical applications, addressing the critical limitations of traditional HA-based materials.

Reference

[1] Jin Woong Lee, Byoungsang Lee, Cheol Hyun Park, Jun Hyuk Heo *et al.*, *In Revision* (2024).

Chunying Chen

National Center for Nanoscience and Technology of China

Email: chenchy@nanoctr.cn

Website: http://english.edu.nanoctr.cas.cn/rf/professors/201502/t20150210_279673.html



Chunying Chen is a professor at National Center for Nanoscience and Technology, China. She is also a New Cornerstone Investigator, and Deputy Director of CAS Key Lab for Biomedical Effects of Nanomaterials and Nanosafety. She received her Bachelor's degree in Chemistry (1991) and PhD degree in Biomedical Engineering (1996) from Huazhong University of Science and Technology of China. She was elected as an Academician of Chinese Academy of Sciences in 2023, Fellow of American Institute for Medical and Biological Engineering in 2021 and Member of Royal Society of Chemistry in 2016.

Her research interests including the analysis of nanoprotein corona, important biological effects such as stealth effect, far-reaching effect and transport-transformation-bioavailability chain, which has guided the application research of nanoadjuvants and drug delivery systems. She has published over 400 peer-reviewed articles including Nature Nanotechnology, Nature Methods, Nature Protocols, Nature Communications, Science Advances, PNAS, JACS and Angew Chem. She has published 8 books, including Nuclear Analytical Techniques for Metallomics and Metalloproteomics by RSC in 2010 and Biomedical Applications and Toxicology of Carbon Nanomaterials by Wiley-VCH in 2016. She been granted over 30 Chinese patents and one PCT patent.

She has received numerous awards, including the Second Prize of the National Natural Science Award, National May Day Female Pacesetter, IUPAC Distinguished Women in Chemistry or Chemical Engineering, TWAS Chemistry Award, RSC Environment Prize, ACS Bioconjugate Chemistry Lectureship award, Chinese Young Female Scientists Award. She is currently an Executive Editor of ACS Nano and editorial board members of several journals.

Exploring the Biological Behavior and Fate of Nanomedicines by Advanced Light Source Analytical Techniques

Chunying Chen*

National Center for Nanoscience and Technology of China

**Email: chenchy@nanoctr.cn*

Exploration of the biological behavior and fate of nanoparticles, as affected by the nanomaterial–biology (nano–bio) interaction, has become progressively critical for guiding the rational design and optimization of nanomedicines to minimize adverse effects, support clinical translation, and aid in evaluation by regulatory agencies. Because of the complexity of the biological environment and the dynamic variations in the bioactivity of nanomedicines, in situ, label-free analysis of the transport and transformation of nanomedicines has remained a challenge. Recent improvements in optics, detectors, and light sources have allowed the expansion of advanced light source (ALS) analytical technologies to dig into the underexplored behavior and fate of nanomedicines in vivo. In this talk, we focus on several selected ALS analytical technologies, including imaging and spectroscopy, and provide an overview of the emerging opportunities for their applications in the exploration of the biological behavior and fate of nanomedicines. We also discuss the challenges and limitations faced by current approaches and tools and the expectations for the future development of advanced light sources and technologies. Improved ALS imaging and spectroscopy techniques will accelerate a profound understanding of the biological behavior of new nanomedicines. Such advancements are expected to inspire new insights into nanomedicine research and promote the development of ALS capabilities and methods more suitable for nanomedicine evaluation with the goal of clinical translation.

References

- [1] M. Cao, K. Zhang, S. Zhang, Y. Wang, C. Chen. *ACS Central Science*, **2022**, 8, 1063-1080.
- [2] M. Cao, R. Cai, L. Zhao, C. Chen, et al. *Nature Nanotechnology*, **2021**, 16, 708-716.
- [3] D. Baimanov, Y. Zhou, L. Wang, C. Chen, et al. *Nature Communications*, **2022**, 13, 5389.
- [4] Z. Fang, C. Wang, C. Chen, L. Wang, Y. Li, et al., *Nature Nanotechnology*, **2022**, 17, 993-1003.
- [5] M. Cao, Y. Wang, C. Chen, et al., *Nature Protocols*, **2024**, 19, 30-59.

Mathieu Salanne

*Professor at Sorbonne University, Paris, France
Director, Institute for computing and data science
Junior member, Institut Universitaire de France
Email: mathieu.salanne@sorbonne-universite.fr
Website: <https://phenix.cnrs.fr/en/directory/?uid=mathieu-salanne>*



Mathieu Salanne is professor of chemistry at Sorbonne University (Paris). His research field of interest is the simulation of electrolytes for energy production and storage, with a focus on methodological developments for the modelling of electrochemical interfaces.

He graduated in chemical engineering from Chimie ParisTech in 2004 and obtained his PhD in 2006. He was appointed assistant professor at Sorbonne University in 2007 and promoted to full professor in 2016. He was group leader (ionic liquids and electrochemistry group) at the PHENIX laboratory from 2014 to 2021, and was appointed as director of the Institute for computing and data science in 2022. Since 2017 he is the leader of the theory group of the French network on electrochemical energy storage (RS2E). He also held a part-time excellence chair in high-performance computing at Paris-Saclay University from 2014 to 2018. He has published more than 170 peer-reviewed journal articles.

His research has been recognized by the IUPAP young scientist prize in computational physics in 2014 for the development of methods to allow realistic atomistic simulation of molten salts and ionic liquids in situations of relevance to electrochemistry. He obtained an ERC consolidator grant in 2017 for the project AMPERE (Accounting for the Metallicity of the electrode, the Polarization of the Electrolyte and Redox reactions in computational Electrochemistry). In 2020 he was appointed as a junior member of Institut Universitaire de France. He was member of the Editorial Advisory Board of the Journal of Chemical Physics (2020-2022) and of the Scientific Steering committee of the Partnership for Advanced Computing in Europe (2020-2023), in which he served as the vice-chair in 2022 and chair in 2023. He currently serves as an Associate Editor for ACS Nano.

Nanostructuring in highly concentrated electrolytes and its impact on electrochemical devices

Mathieu Salanne*

*Sorbonne Université, CNRS, Laboratoire PHENIX, 75005 Paris, France
Institut Universitaire de France, 75231 Paris, France*

**E-mail: mathieu.salanne@sorbonne-universite.fr*

Electrolytes have gained a lot of attention in the fields of electrochemical energy storage and hydrogen production. While they were traditionally viewed as the simpler component of the device, only allowing for ionic charge transfer between the two electrodes, it is now established that they play a much more active role. In particular, the introduction of highly concentrated salts, such as water-in-salts, has challenged our understanding of solvation phenomena: The structural and physical changes occurring in these liquids are multifaceted. In particular, it is now well-established that highly concentrated electrolytes display strong nanostructuring effects, such as the formation of clusters, nanodomains [1] and even nanochains [2]. This presentation will highlight the importance of these nano-heterogeneities in the dynamics of the ionic species as well as the interfacial reactivity of the species. I will show how molecular simulations can be combined with electrochemistry and spectroscopy/diffraction techniques to establish structure/properties relationship that will allow the design of future electrolytes with enhanced performances [3]. I will also discuss how the observations made for highly concentrated electrolytes could be extended to the case of dilute systems under nanoconfinement [4] or at electrochemical interfaces [5].

References

- [1] A. Serva, N. Dubouis, A. Grimaud, M. Salanne, *Acc. Chem. Res.* **2021**, *54*, 1034.
- [2] K. Goloviznina, A. Serva, M. Salanne, *ChemRxiv* **2023**, doi: 10.26434/chemrxiv-2023-1v49c.
- [3] N. Dubouis, A. Serva, R. Berthin, G. Jeanmairat, B. Porcheron, E. Salager, M. Salanne, A. Grimaud, *Nat. Catal.* **2020**, *3*, 656.
- [4] J. Wei et al., *Adv. Mater.* **2022**, *34*, 2107439.
- [5] J. Wang et al., *ACS Nano* **2024**, *18*, 1181.

July. 3 (16:30-16:45)

Wolfgang J. Parak

University of Hamburg, Hamburg, Germany

Email: wolfgang.parak@uni-hamburg.de

Website: <http://wolfgang.parak@uni-hamburg.de>

<https://www1.physik.uni-hamburg.de/en/inf/ag-parak/team/wolfgang-parak.html>



Wolfgang Parak is Professor at the University of Hamburg. He has studied physics and obtained his PhD in Munich. After a postdoctoral fellowship at Berkeley he returned 2003 to Munich to start his own group. Before moving to the University of Hamburg in 2017 he spent 10 years as professor at the Philipps University Marburg. The research of Wolfgang Parak is dedicated towards the development of new surface chemistries of inorganic nanoparticles and towards the characterization of their physicochemical properties. In particular, the development of an amphiphilic polymer coating is nowadays used by many different groups worldwide. Nanoparticles with such high colloidal stability are the bases of experimentally correlating their physicochemical properties with their interaction with cells (involving uptake and cytotoxicity), which has been the research topic of the Parak group for the 2 decades. The group also uses polymeric polyelectrolyte capsules fabricated by layer-by-layer assembly for biological applications (in vitro sensing and delivery). Personal Home Page: <https://www1.physik.uni-hamburg.de/en/inf/ag-parak/team/wolfgang-parak.html>

Quantitative Interaction of colloids with cells

Wolfgang J. Parak*

Universität Hamburg, Hamburg, Germany

**E-mail: wolfgang.parak@uni-hamburg.de*

When cells internalized nanoparticles via endocytosis this involves also proteins bound to the surface of the nanoparticles. After internalization, the original protein corona may be partly exchanged. In case the proteins bear labels providing contrast for imaging, the in vivo distribution of the originally bound proteins as well as the one of the nanoparticles can be determined. This can be done for example with fluorescence or X-ray fluorescence based method. Colocalization analysis then provides information about the degree in which the original protein corona is retained.

Most studies about the interaction of nanoparticles (NPs) with cells are focused on how the physicochemical properties of NPs will influence their uptake by cells. However, much less is known about their potential excretion from cells. In order to control and manipulate the number of NPs in a cell however both, cellular uptake and excretion need to be studied quantitatively. Monitoring the intracellular and extracellular amount of NPs over time (after residual non-internalized NPs have been removed), enables to disentangle the influence of cell proliferation and exocytosis, which are the major pathways for the reduction of NPs per cell. Proliferation depends on the type of cells, and exocytosis depends in addition to the type of cells also on the properties of the NPs, such as their size. Examples are given on the role of these two different processes for different cells and NPs.

July. 3 (16:45-17:00)

Hyeon Suk Shin

Fellow of Royal Society of Chemistry

Director / Center for 2D Quantum Heterostructures, Institute for Basic Science

Professor / Department of Energy Science, Sungkyunkwan University (SKKU)

Associate editor / npj 2D Materials and Applications

E-mail: shin0902@skku.edu

Web: <http://www.ibs.re.kr/2dqh>



Hyeon Suk Shin is the director of IBS Center for 2D Quantum Heterostructures at SKKU and a professor at Department of Energy Science, SKKU. Before joining IBS center and SKKU, he was a UNIST endowed chair professor at Department of Chemistry, Ulsan National Institute of Science and Technology (UNIST), Korea. He received his PhD from Department of Chemistry at POSTECH in 2002. After working as a postdoctoral fellow at University of Cambridge, UK and subsequently as a research Professor at POSTECH, he joined UNIST in 2008 and recently moved to SKKU to become the director of the IBS center at SKKU in 2024. He received ‘Scientist of the Month’ award (Ministry of Science and ICT) in 2023, Grand Academic Award (UNIST) in 2023, ‘Top 100 National R&D Outstanding Achievements’ award (Ministry of Science and ICT) in 2021, Sigma-Aldrich Excellent Chemist Award (Korean Chemical Society) in 2021, Basic Researcher of the Year award (Ministry of Science and ICT, Republic of Korea) in 2020, Creative Knowledge Award (Minster Award by Ministry of Science, ICT, and Future Planning) in 2015, outstanding researcher award (Materials Chemistry Division, KCS) in 2015, the Faculty of the Year award of UNIST in 2014, and the Minister award of Ministry of Knowledge Economy, Korea in 2012. His current research focuses on 2D materials, their amorphous structures, and their applications for energy conversion and storage.

Hexagonal and amorphous boron nitride thin films

Hyeon Suk Shin*

Center for 2D Quantum Heterostructures, Institute for Basic Science (IBS), Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea
Department of Energy Science, Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea

*E-mail: shin0902@skku.edu

Hexagonal boron nitride (hBN) is a promising two-dimensional (2D) material owing to its unique optical properties in the deep-UV region, mechanical robustness, thermal stability, and chemical inertness. hBN thin films have gained significant attention for various applications, including nanoelectronics, photonics, single photon emission, anti-corrosion, and membranes. Thus, wafer-scale growth of hBN films is crucial to enable their industrial-scale applications. In this regard, chemical vapor deposition (CVD) is a promising method for scalable high-quality films. To date, considerable efforts have been made to develop continuous hBN thin films with high crystallinity, from those with large grains to single-crystal ones, and to realize thickness control of hBN films by CVD. However, the growth of wafer-scale high crystalline hBN films with precise thickness control has not been reported yet. The hBN growth is significantly affected by substrate, in particular the type of metals, because the intrinsic solubilities of boron and nitrogen depend on the type of metal. In this talk, state-of-the-art strategies adopted for growing wafer-scale, highly crystalline hBN are summarized, followed by the proposed mechanisms of hBN growth on catalytic substrates [1]. Furthermore, various applications of the hBN thin films are demonstrated, including a dielectric layer, an encapsulation layer, a wrapping layer of gold nanoparticles for surface enhanced Raman scattering, a proton-exchange membrane, a template for growth of other 2D materials or nanomaterials, and a platform of fabricating in-plane heterostructures. In addition, amorphous BN (aBN) as a counterpart of crystalline hBN is introduced [2]. Detailed structural characterisation indicates that a-BN is sp^2 -hybridised, with no measurable crystallinity, and mechanically robust, with excellent diffusion-barrier characteristics. The aBN thin film shows ultra-low dielectric constant (< 2.5), indicating great potential for its applications in Cu interconnects of integrated circuits.

References

- [1] K. Y. Ma, H. S. Shin et al., Nature 606, 88 (2022).
- [2] S. Hong et al., Nature 582, 511 (2020).

Boseok Kang

*Associate Professor
SKKU Advanced Institute of Nanotechnology (SAINT)
Department of Nano Science and Technology
Department of Nano Engineering
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: bskang88@skku.edu
Website: <https://sites.google.com/view/kangs-group>*



Boseok Kang is an associate professor at the SAINT at SKKU. He received his Ph.D. degree in Chemical Engineering from Pohang University of Science and Technology (POSTECH) in 2015. Subsequently, he served as a postdoctoral researcher at the Global Frontier Research Center for Advanced Soft Electronics (2016–2019) and at the Cavendish Laboratory, University of Cambridge (2018–2019). Prof. Kang joined the faculty at SKKU in 2019 as an assistant professor and was promoted to associate professor in 2023. He has received several awards, including the Young Scientist Award from the Korean Synchrotron Radiation User's Association (2019), the Polymer Society of Korea (2022), and the Korea Flexible & Printed Electronics Society (2024).

Prof. Kang's research focuses on functional polymers for the semiconductor and display industries. His group is dedicated to pushing the boundaries of polymer science and engineering to harness the exceptional properties of emerging polymeric materials for practical applications. These materials include polymer (semi-)conductors, two-dimensional conjugated organic frameworks, perylene derivatives, polyimides, and organogels. The distinctiveness of his research lies in the integration of sophisticated organic chemistry, printing and vacuum technology for device fabrication, and synchrotron-based structural analysis. This multidisciplinary approach allows his group to explore previously uncharted structure-property-function relationships, essential for the development of novel applications of new polymeric materials. The newly synthesized polymers have immense potential for various applications, including stretchable logic gates, electrochemical transistors, thermoelectric generators, and advanced sensors. To date, Prof. Kang has published over 100 scientific papers in international journals, with a total citation count of 3,900 and an H-index of 35 (Google Scholar, June 2024).

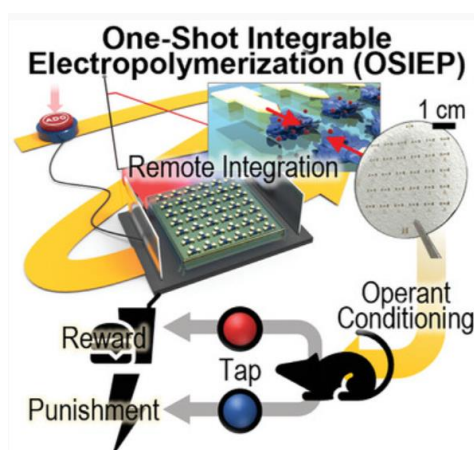
De Novo Synthetic Approaches of π -Electronic Macromolecules for Emerging Electronic Applications

Boseok Kang*

SKKU Advanced Institute of Nanotechnology (SAINT), Department of Nano Science and Technology, and Department of Nano Engineering, Sungkyunkwan University (SKKU), Suwon 16419 (Republic of Korea)

**Email: bskang88@skku.edu*

Since the pioneering discovery of doped polyacetylene in the 1970s, polyaromatic materials such as polythiophene, polypyrrole, and polyaniline have introduced a new dimension to the field of electronics in the early 1980s. The emergence of the new materials sparked extensive research into their chemical synthesis and application in devices like organic photovoltaics, light-emitting diodes, transistors, and sensors. Especially, advancements in solvent-based synthesis, including solution and electrochemical polymerization, have enabled the preparation of high-performance thin polymer films for electronics. In this presentation, I will present groundbreaking synthetic approaches that produce new-type (semi-)conducting polymer films with superior electronic properties, high yields, and high reliability. I will introduce an innovative electropolymerization technique that combines an alternating and direct current (ADC) and dual bipolar electrodes. Our novel ADC bipolar electropolymerization method uniquely enables the rapid and uniform growth of conductive polymer films on insulating substrates with remote controllability, potentially forging a path for patterning-required microelectronics applications. These innovative techniques pave the way for integrating functional polymers into emerging electronic devices, including flexible and neuromorphic transistors, as well as sensors for gas detection and brain temperature monitoring.



Reference

- [1] J. Lee, T. W. Yoon, S. Chung, K. Cho, G. Zhang, and B. Kang*, "Remote-Controllable Lateral Electropolymerization of Conducting Polymers via Dual-Electrode ADC-Bipolar Electrochemistry", *Adv. Funct. Mater.*, 2024, 10.1002/adfm.202406229.
- [2] J. Lee†, J. Lee†, H. Bang, T. W. Yoon, J. H. Ko, G. Zhang, J.-S. Park, I. Jeon, S. Lee, and B. Kang*, "One-Shot Remote Integration of Macromolecular Synaptic Elements on a Chip for Ultrathin Flexible Neural Network System", *Adv. Mater.*, 2024, doi/10.1002/adma.202402361.

July. 3 (17:15-17:30)

Sungjoo Lee

*Director, SKKU Advanced Institute of Nanotechnology
Director, BK4+ Education/Research Center of Nano Convergence
Department of Nano Science & Technology,
Department of Nano Engineering
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Associate Editor of InfoMat
Email: leesj@skku.edu
Website: <https://ndtl.skku.edu/>
<https://saint.skku.edu/saint/>*



Dr. Lee graduated from Seoul National University with a B.S degree in Electrical Engineering in 1989. After working at Samsung Electromechanics R&D Center as a senior research engineer, he obtained his Ph.D. degree from the University of Texas at Austin in Electrical and Computer Engineering in 2002. After graduating, he worked at the MIRAI group in Japan, as a researcher at the National Institute of Advanced Industrial Science and Technology (AIST) in 2002~2003. He was with the National University of Singapore (NUS) at the Department of Electrical and Computer Engineering in 2003-2011. He joined SAINT (SKKU Advanced Institute of Nanotechnology) at Sungkyunkwan University in 2011 and served as a director from 2019 till now. His current research interests are in new and innovative materials, functional nanostructures, and process technology of future nanoscaled ICT devices.

Spiking neural network integrated with impact ionization field-effect transistor neuron and a ferroelectric field-effect transistor synapse

*Sungjoo Lee **

*SKKU Advanced Institute of Nanotechnology (SAINT), Sungkyunkwan University, Suwon, 16419
(Republic of Korea)*

**E-mail: leesj@skku.edu*

The integration of artificial spiking neurons based on steep-switching logic devices and artificial synapses with neuromorphic functions enables an energy-efficient computer architecture that mimics the human brain well, known as a spiking neural network (SNN). Two-dimensional (2D) materials with impact ionization or ferroelectric characteristics have the potential for use in such devices. However, research on 2D spiking neurons remains limited, and investigations of 2D artificial synapses far more common. An innovative 2D spiking neuron is implemented using a WSe₂ impact ionization transistor (I²FET), while a spiking neural network is formed by combining it with a 2D ferroelectric synaptic device (FeFET). The suggested 2D spiking neuron demonstrates precise spiking behavior that closely resembles that of actual neurons. In addition, it achieves a low energy consumption of 2 pJ/spike. The better impact ionization properties of WSe₂ were responsible for this efficiency. Furthermore, an all-2D SNN consisting of 2D I²FET neurons and 2D FeFET synapses is constructed, which achieves high accuracy of 87.5 % in a face classification task by unsupervised learning. The integration of a 2D SNN with 2D steep-switching spiking neuronal devices and 2D synaptic devices shows great potential for the development of neuromorphic systems with improved energy efficiency and computational capabilities.

July. 3 (17:30-17:45)

SeungNam Cha

*Professor, Department of Physics
Sungkyunkwan University (SKKU)
Tel +82-31-299-4546 Email chasn@skku.edu
Homepage <https://sites.google.com/view/neolabskku>*



Prof. Cha is a professor of Physics at Sungkyunkwan University, specializing in the study of physical phenomena in various nanomaterials and functional materials, including electronics, optoelectronics, and energy devices. He received his early education in Physics at Korea University and later earned his Ph.D. from the University of Cambridge in 2007. He was a senior researcher at Samsung Advanced Institute of Technology and an Associate Professor at Oxford University. Professor Cha's work has been published extensively in more than 175 SCI journals (h-index 40, Citation > 5800) and filed/pending 95 patents

Work Function Engineering of Copper Sulfides for 2D Electronics

SeungNam Cha *

Department of Physics, Sungkyunkwan University, Suwon 16419 (Republic of Korea)

**E-mail: chasn@skku.edu*

Recently, extensive research has been conducted on realizing devices with atomic-scale layered 2D semiconducting materials. Because 2D materials have various energy bands and fermi levels, their vast potential is hindered by unfavorable energy level matching with electrode materials, which crucially determines the electrical properties of the device. Therefore, choosing the proper electrode material is one of the most effective contact engineering strategies for realizing ideal 2D electronic devices. In this work, we propose an efficient work function engineering strategy in copper sulfide electrode materials through a simple sulfurization process. The tunable work function of the electrode material allows the formation of favorable junction with both of n-type and p-type 2D channel materials. Our efficient work function engineering strategy provides a way to comprehensive design in 2D electronics devices.

July. 3 (17:45-18:00)

Changgu Lee

SKKU Fellow

Professor

Department of Mechanical Engineering

Sungkyunkwan University (SKKU)

Suwon 16419, Korea

Email: peterlee@skku.edu

Website: <https://gel.skku.edu>



Prof. Changgu Lee has been working as a professor in the department of Mechanical Engineering at Sungkyunkwan University since September 2010. He has also a joint position in SKKU Advanced Institute of Nanotechnology. Before joining SKKU, he worked as a postdoctoral researcher in James Hone's group in New York, USA from 2006 to 2010. He started researching graphene and 2D materials there. He published 2 papers in the journal Science as the first author by studying mechanical and tribological properties of graphene and 2D materials. He is one of the earliest researchers, who began to study 2D materials other than graphene, such as h-BN and MoS₂. Among the earliest works are Raman and PL studies of MoS₂, which revealed the thickness dependence of optical properties of MoS₂, and h-BN as a clean substrate for graphene and 2D materials electronic devices. His current research interest is in synthesis of various 2D materials, such as graphene, h-BN, MoS₂, NbS₂, Cr₂Se₃, Fe₃GeTe₂, and etc. Using those synthesized materials, he is developing composites, and electronic and magnetic devices. He has published more than 100 scientific papers in international journals and his total citation number exceeds over 70,000 times with H-index of 45 (Google Scholar, May. 2024)

Electrical characterization of van der Waals ferromagnets

*Changgu Lee**

Department of Mechanical Engineering, Sungkyunkwan University, Suwon 16419 (Republic of Korea)

**Email: peterlee@skku.edu*

The representative 2D materials, graphene, h-BN, and MoS₂, have interesting mechanical, electrical and optical properties and have exhibited fascinating physical phenomena so far. However, they mostly lack one important physical property in physics, magnetism. The new 2D materials such as CrSiTe₃, CrI₃, and FePS₃, which began to be studied recently, possess ferro- or antiferro-magnetic properties even in atomic level thickness and are expected to reveal deep level of physics in 2-dimensional confinement.

In this talk, our recent works on electrical characterization of a 2D ferromagnet (Fe₃GeTe₂)-based heterostructures and their exotic properties. From the hall measurement, Fe₃GeTe₂ exhibited the anomalous hall effect due to its intrinsic ferromagnetism [1]. Interestingly, the magnetic properties such as coercivity changed significantly with decreasing thickness changing from weak ferromagnet to strong ferromagnet. In the heterostructure of Fe₃GeTe₂/Graphite/Fe₃GeTe₂, Hall measurement showed an exotic 3-states of resistance due to the spin-polarized current at the interfaces [2]. In the Fe₃GeTe₂/CrPS₄ (FM/AFM) heterostructure, exchange bias was observed below the Neel temperature of the AFM layer. The exchange bias was dependent on the thickness variation of the AFM layer, and down to bilayer of AFM layer the exchange bias was maintained. Also, it could be controlled by applying electric potential.

Reference

[1]]. Lee, S. J. Yun, S. H. Choi, and K. K. Kim et al., in preparation (2024).

July. 3 (18:00-18:15)

Taeyeon Kim

*Assistant Professor
Department of Chemistry
Sungkyunkwan University (SKKU)
Suwon 16419, Korea
Email: taeyeon@skku.edu
Website: <https://phd.skku.edu>*



Taeyeon Kim is an Assistant Professor in the Department of Chemistry at Sungkyunkwan University in Suwon, Korea. Prof. Kim received B.S. in Chemistry from Yonsei University in February 2015, and Ph.D. in Chemistry from Yonsei University in February 2021. From April 2021 to December 2022, he was a postdoctoral researcher in the Department of Chemistry at Northwestern University. In February 2023, he joined Sungkyunkwan University. His past research experience includes exciton & charge-transfer dynamics in model molecular systems. His primary research interest is developing ultrafast multidimensional spectroscopic tools and utilizing them in various organic molecules and emerging energy materials.

Intra nanogap effect in electron dynamics and acoustic vibrations of Au nanostructures

Taeyeon Kim*

¹Department of Chemistry, Sungkyunkwan University, Suwon 16419 (Republic of Korea)

**Email: taeyeon@skku.edu*

Metallic nanostructures have unique optical properties such as localized surface plasmon resonance (LSPR), which results from the collective oscillation of conduction electrons coupled with incident electromagnetic fields. The metallic nanostructures, for example, Au nanostructures have a wide range of applications among nanostructures due to their lower toxicity. Au nanostructures have enormous applications such as biomedical imaging, photothermal therapy, drug delivery, photocatalysis, and solar cells. Au nanoring (Au NR) has a large surface-to-volume ratio and high refractive index sensitivity.

This work aims to broaden our knowledge of electron dynamics and acoustic vibrations of Au nanostructures such as circular single nanoring (CSNR), circular double nanoring (CDNR), and circular triple nanoring (CTNR). The common factor in these three samples is the intra-nanogap, an important feature of the nanorings. In this article, we investigated these three samples with two other reference samples such as nanosphere (NS) and circular nanoplate (CNP). To study the effect of the nanogap on electron dynamics and acoustic vibrations, Au CSNR, Au CDNR, and Au CTNR were prepared and investigated with transient absorption (TA) spectroscopy. These structures are expected to exhibit enhanced interaction with light and surrounding media due to a larger exposed surface than solid nanostructures. Our experimental results suggest that the intra nanogap plays a crucial role in the electron dynamics and acoustic vibrations.

Reference

[1] F. Yesudas, S. Lee, S.-H. Ji, S. Noh, S. Park, T. Kim in preparation (2024).

Poster Session

| Poster Session | Name | Affiliation | Title |
|----------------|---------------------------|--|---|
| PS-01 | Debottam Daw | Department of Energy Science | Ultrafast Polarization Switching in 2D Negative Capacitance Dirac Source Transistor |
| PS-02 | Ashok Mondal | Department of Energy Science | Low Ohmic contact resistance and high on/off ratio in transition metal dichalcogenides field-effect transistors via residue-free transfer |
| PS-03 | Jiyun Lee | SKKU Advanced Institute of Nanotechnology | One-shot Integration of Biomimetic Elements for Ultrathin Neural Net System |
| PS-04 | Hoimin Kim | SKKU Advanced Institute of Nanotechnology | From Non-Doped to Dopable: Functional Group Engineering of Highly Doped Conjugated Polymer |
| PS-05 | Jihyun Kim | School of Advanced Materials Science & Engineering | Solution-processed van der waals thin film for high-performance and scalable electronics |
| PS-06 | Yunseong Cho | School of Advanced Materials Science & Engineering | Solution processing for thickness-dependent electronic and electrocatalytic applications of multi-functional 2D PtSe ₂ |
| PS-07 | Hayoung Ko | Department of Energy Science | Atomic sawtooth-like metal films for vdW-layered single-crystal growth |
| PS-08 | Balakrishnan Kirubasankar | Department of Energy Science | A Robust and Highly Active Bimetallic Phosphide/Oxide Heterostructure Electrocatalyst for Efficient Industrial-scale Hydrogen Production |
| PS-09 | Andrew Ben Smith | Department of Energy Science | Photo-oxidative Crack Propagation in Transition Metal Dichalcogenides |
| PS-10 | Yong Jun Choi | Department of Advanced Materials Science & Engineering | Enhancing Mechanical Durability and Stretchability in Multiscale Piezoelectric Helical Coil Systems for Self-Powered Textile Sensing |

| | | | |
|-------|----------------|--|--|
| PS-11 | Hyungyong Kim | Department of Advanced Materials Science & Engineering | Ultrahigh Dielectric Constant and Superior Thermal Stability of (1-x)(K, Na)NbO ₃ -xSrZrO ₃ Ceramics for X8R Multilayer Ceramic Capacitors |
| PS-12 | Yongjae Cho | Institute of Quantum Biophysics | Application of sensitive immuno-SERS for AD biomarker detection on human cerebral brain organoids |
| PS-13 | Seho Lee | Intelligent Precision Healthcare Convergence | Ultrafast Photonic PCR with All-solution-processed Perfect Absorber |
| PS-14 | Freeda Yesudas | Department of Chemistry | Intra nanogap effect on electron dynamics and acoustic vibrations of Au nanostructures |
| PS-15 | Seunghyun Noh | Department of Chemistry | Exciton Dynamics in Materials for Organic Heterostructures using Transient Absorption Microscopy |
| PS-16 | Heewon Choi | Department of Electrical and Computer Engineering | Injectable tissue prosthesis for instantaneous closed-loop rehabilitation |
| PS-17 | Yewon Kim | Department of Electrical and Computer Engineering | Adhesive bioelectronics for sutureless epicardial interfacing |
| PS-18 | TBA | | |
| PS-19 | TBA | | |
| PS-20 | Taeho Kang | SKKU Advanced Institute of Nanotechnology | 2D semiconductor gate stack and implementation of steep-switching impact ionization transistors |
| PS-21 | Sungpyo Baek | SKKU Advanced Institute of Nanotechnology | Ferroelectric 2D materials and implementation of logic-in-memory computing devices |
| PS-22 | Daihwan Kim | School of Advanced Materials Science & Engineering | Dual enzyme-catalysis immobilized hydroxyapatites for nondestructive and continuous tooth whitening |
| PS-23 | Jina Bae | School of Advanced Materials Science & Engineering | Whitlockite substituted by 3d orbital transition metals: an advanced synthesis, characterization and mechanical properties |

| | | | |
|-------|---------------|---|---|
| PS-24 | Kyuyeon Won | Department of Mechanical Engineering | Spectroscopic signatures of ultra-thin amorphous carbon with the tuned disorder directly grown on a dielectric substrate |
| PS-25 | Hyobin Ahn | SKKU Advanced Institute of Nanotechnology | Phase transition from Ferromagnet to Antiferromagnet induced by Co-doping in room-temperature vdW Ferromagnet |
| PS-26 | Jiye Han | SKKU Advanced Institute of Nanotechnology | Upcycled carbon-encapsulated iron carbide nanoparticles for gap plasmon applications in perovskite solar cells |
| PS-27 | Jinmyung Choi | SKKU Advanced Institute of Nanotechnology | Super Ultra-thin Polyimide-Carbon Nanotube Nanocomplex Annulling Yellowness Index Towards High Performance Foldable Solar Cells |
| PS-28 | Youngwook Cho | School of Chemical Engineering | Real-Time Monitoring of Photoaging Kinetics in High Spatiotemporal Resolution Using nIR Fluorescent Nanosensor Array |
| PS-29 | Seungju Lee | School of Chemical Engineering | Rapid Detection of Cerebrospinal Fluid Leakage through Nasal Mucus using a nIR Fluorescent Single-Walled Carbon Nanotube Sensor |
| PS-30 | Abebual Molla | School of Chemical Engineering | Supported Lipid Membrane Platforms for Characterizing Biophysical Mechanism of Alkylphospholipids |
| PS-31 | Changjun Lee | School of Chemical Engineering | Virus-Mimicking Biophysical Measurement Strategies for Testing Antiviral Surfactants and Peptides |
| PS-32 | Jungmoon Lim | Department of Physics | Work Function Engineering of Copper Sulfides |
| PS-33 | Junsung Byeon | Department of Physics | Vertically Stacked Ultra-Short Channel Field-Effect Transistor with sloped MoS ₂ Channel |