XIX th RENCONTRES DU VIETNAM
Gặp gỡ Việt Nam lần thứ 19

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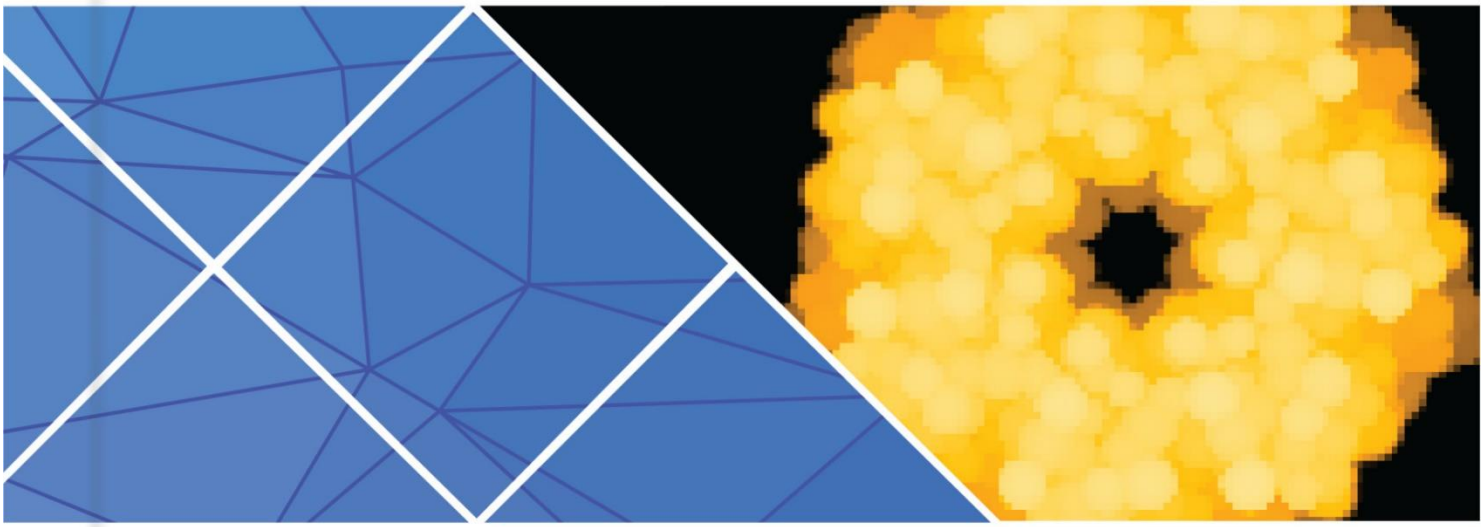
# ABSTRACT BOOK

*September 17 - 19, 2023*



1st

# INTERNATIONAL SYMPOSIUM OF NANO LIFE SCIENCE:

*Nano Biotechnology, Biosensor, Computation*

*Scientific program*

## SCIENTIFIC ADVISORY COMMITTEE

- **Prof. Dr. Noriyuki Kodera**
  WPI Nano Life Science Institute, Kanazawa University, Kanazawa, Japan
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  CSIR – Institute of Genomics and Integrative Biology (CSIR-IGIB), New Delhi, India
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- **Prof.Dr. Nguyen The Toan**
  Vietnam National University, Hanoi, Vietnam

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  Phenika University Nano Institute, Hanoi, Vietnam
- **Assoc.Prof.Dr. Nguyen Duc Hoang**
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- **Assoc.Prof.Dr. Hang T. Ta**
  Griffith University, Australia
- **Assist.Prof.Dr. Cam Ha Tran**
  University of Nevada, Reno, USA
- **Assist.Prof.Dr. Tran Phuoc Duy**
  Tokyo University of Technology, Tokyo, Japan
- **Dr. Ngo Ba Duy**
  Nong Lam University, HCMC, Vietnam
- **Dr. Thu Thi Vu**
  University of Science and Technology Hanoi, Vietnam

## ORGANIZING COMMITTEE

- **Chairman: Assoc.Prof.Dr. Nguyen Bao Quoc**
  Nong Lam University, HCMC, Vietnam
- **Co-Chairman: Assist.Prof.Dr. Ngo Xuan Kien**
  WPI Nano Life Science Institute, Kanazawa University, Kanazawa, Japan
- **Assoc.Prof.Dr. Tran Quang Huy**
  Phenika University Nano Institute, Hanoi, Vietnam
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- **Assist.Prof.Dr. Cam Ha Tran**
  University of Nevada, Reno, USA
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  ICISE, Quy Nhon, Binh Dinh, Vietnam

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- **Ms. Nguyen Thi Loi**
  ICISE, Quy Nhon, Vietnam
- **Ms. Tran Pham Quynh Nhu**
  ICISE, Quy Nhon, Vietnam
- **Mr. Nguyen Trong Nhan**
  ICISE, Quy Nhon, Vietnam
- **Mr. Nguyen Mai Nghiep**
  Nong Lam University, HCMC, Vietnam

## Preface

Nano life science is an interdisciplinary field that brings together scientists and engineers from various backgrounds to explore the potential of nanotechnology in improving our understanding of life processes and advancing medical and biological applications. It holds great promise for revolutionizing healthcare, diagnostics, and our fundamental understanding of biology. This year, Rencontres du Vietnam presents the inaugural International Symposium of Nano Life Science: Nano Biotechnology, Biosensors, and Computational Methods (NanoBioCoM2023), with a primary focus on both fundamental and practical research in the domains of Nano Biotechnology, Biosensors, and Computational Methods, all directed towards addressing contemporary challenges in the life sciences. The presentations featured at this symposium promise to provide attendees with valuable insights into innovative techniques and emerging research directions applicable within the field of Nano Life Sciences. This event will take place at the International Center for Science and Interdisciplinary Education (ICISE) in Quy Nhon City, Binh Dinh Province, Vietnam.

Addressing disparities between single molecule experiments and ensemble-averaged experiments holds paramount significance within the realm of nano life sciences. The primary objective of this workshop is to introduce a comprehensive array of experimental and computational methodologies pertinent to contemporary nano life science, with the capacity to elucidate these distinctions. Vietnam, a burgeoning nation with an approximate population of 100 million, is actively cultivating research initiatives in the field of nano life sciences, encompassing nano biotechnology (such as HS-AFM, FM-AFM, SICM), biosensors (including color, heat, and chemical sensors), and deep machine learning. This symposium aims to further invigorate these research endeavors by extending invitations to a diverse panel of experts from both Vietnam and the broader Asian region, who will deliver structured presentations on topics within the realm of nano life science. The featured computational techniques will span from coarse-grained simulations to molecular dynamic approaches.

The symposium has received 74 abstract for plenary, keynote, invited, oral and poster presentations. There have been 33 abstracts assigned in oral and 15 abstracts assigned in poster session. Presenters come from 15 countries including Bangladesh, Canada, China, France, German, India, Japan, Pakistan, Philippines, Poland, Sri Lanka, Taiwan, Thailand, USA, and Vietnam as well as 44 universities and research institutes. There are also representatives of Indian Society of Biophysics, Japanese Society of Biophysics and Asian Society of Biophysics at this event.

Finally, we would like to show our great appreciation to Prof. Jean Tran Thanh Van –President of Rencontres du Vietnam, Director of ICISE Quy Nhon, Prof. Le Kim Ngoc (Rencontres du Vietnam) for more generous financial support to this event. We are truly grateful to valuable supports from Kanazawa University, Nong Lam University, UIPAB, VINIF, and JSPS

Thank you so much for joining in NanoBioCoM2023 in ICISE, Quy Nhon and wishing you all the best time at the workshop.

Quy Nhon, September 2023

Organizing Committee of NanoBioCoM2023

# CONTENTS

# Rencontres du Vietnam
# The First International Symposium of Nano Life Science:
## Nano Biotechnology, Biosensor, Computation (NanoBiocom2023)

ICISE, Quy Nhon City, Binh Dinh province, Vietnam
17-19 September, 2023

# PROGRAMME

| | | |
|---|---|---|
| ***Saturday, 16th September, 2023*** | | |
| All day | Welcome invited guests and delegates to Quy Nhon City | |
| 18:00 ~ | Meeting of the NanoBioCom2023 organizing committee | Seagull hotel, An Duong Vuong, Quy Nhon City |
| **Sunday, *17th September, 2023*** | | |
| 7:30 ~ 8:30 | Moving to ICISE from Seagull Hotel by Shuttle Buses | |
| 8:00 – 16:00 | Opening registration and poster hanging | *ICISE, Quy Nhon City* |
| **Chair: Assoc. Prof. Nguyen Bao Quoc** | | |
| 8:30 – 8:35 | Welcome address | **Assoc. Prof. Dr. Nguyen Bao Quoc**<br>Chair of Organizing Committee, NanoBiocom2023 |
| 8:35 – 8:45 | Opening remarks | **Prof. Jean Tran Thanh Van**<br>Rencontres du Vietnam and ICISE |
| 8:45 – 9:00 | Welcome remarks | **Assoc.Prof.Dr. Nguyen Tat Toan**<br>Vice president, Nong Lam University, Ho Chi Minh City, Vietnam<br><br>**Prof.Dr. Noriyuki Kodera**<br>WPI Nano LSI, Kanazawa University, Japan |
| **Plenary talks – Main Hall** | | |
| **Chair: Prof.Dr. Toan The NGUYEN** | | |
| 9:00 – 9:40 | **Plenary lecture 1 (PO-01)**: | |

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|---|---|---|
| | *In silico study of Covid-19* | **Prof.Dr. Li Suan MAI**<br>[1]Inst. of Phys., Polish Acad. of Sci., Poland;<br>[2]Inst. for Comp. Sci. and Tech., Vietnam |
| | | |
| 9:40 – 10:20 | **Plenary lecture 2 (PO-02):**<br>*Encoding and decoding of molecular information in distributed cellular systems with feedback control* | **Prof.Dr. Madan RAO**<br>President – Indian Biophys. Soc.<br>Nat. Cent. for Biol. Sci. (TIFR), India |
| | | |
| 10:20 – 11:00 | **Group photo**<br>Tea break and poster visiting | |
| **Keynote talks – Main Hall** | | |
| **Chair: Prof.Dr. Li Suan MAI**<br>**Co-chair: Assist.Prof.Dr. Kien Xuan NGO** | | |
| | | |
| 11:00 – 11:30 | **Keynote lecture 1 (KO-01):**<br>*High-speed atomic force microscopy for studying dynamic behaviors of biomolecules* | **Prof. Dr. Noriyuki KODERA**<br>WPI Nano Life Science Institute, Kanazawa University, Japan |
| | | |
| 11:30 – 12:00 | **Keynote lecture 2 (KO-02):**<br>*Machine learning application to biomedicine research at the VNU Key Laboratory for multiscale simulation of complex systems* | **Prof.Dr. Toan The NGUYEN**<br>Uni. of Sciences, Vietnam Nat. Uni., Hanoi, Vietnam |
| | | |
| **Chair: Assoc. Prof. Nguyen Bao Quoc** | | |
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| 12:00 – 12:15 | **Talk of special guest**:<br>*WPI: Toward enhancing and strengthening "Highly Visible Research Centers"* | **Ms. Toshie FUKUDA**<br>Deputy Director<br>Japan Society for the Promotion of Science – JSPS – Bangkok Office |
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| 12:15 - 12:30 | **TBA** | **TBA**<br>VINIF |
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| 12:30 – 13:30 | Lunch break | *ICISE, Quy Nhon City* |
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| 13:30 – 14:00 | Poster presentation | |
| | | |
| **Keynote talks – Main Hall** | | |
| **Chair: Prof.Dr. Noriyuki KODERA** | | |
| 14:00 - 14:30 | **Keynote lecture 3 (KO-03)**:<br>*Impedimetric sensing for (bio)matter recognition* | **Prof.Dr. Congo Tak Shing CHING**<br>Nat. Chung Hsing Uni., Taiwan |
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| **Concurrent sessions** | | |
| | **Nano Biotechnology - Main Hall** | **Biosensor – Meeting Room 1** | **Computation – Meeting Room 2** |

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|---|---|---|---|
| | **Chair: Prof.Dr. Mikihiro SHIBATA**<br>**Co-chair: Prof.Dr. Gopinath PACKIRISAMY** | **Chair: Assoc.Prof.Dr. Werasak SURAREUNGCHAI**<br>**Co-chair: Assist.Prof. Dr. Cam Ha T. TRAN** | **Chair: Assist.Prof.Dr. Holger FLECHSIG**<br>**Co-chair: Dr. Hien Bich VO** |
| | | | |
| 14:40 – 15:05 | **Invited speaker 1 (IO-01):**<br>*Advances in nanoformulation of natural compounds*<br><br>**Assoc.Prof.Dr. Tran Quang Huy**<br>Phenika University Nano Institute, Hanoi, Vietnam | **Invited speaker 6 (IO-06):**<br>*Modulatory effects of noradrenergic and serotonergic signaling pathway on neurovascular coupling*<br><br>**Assist.Prof.Dr. Cam Ha T. TRAN**<br>Uni. of Nevada, USA | **Invited speaker 9 (IO-9):**<br>*Sampling the conformational transition of the monomer of Nsp15 of the SARS-nCoV2 gives a hint to inhibit its hexamer*<br><br>**Assist.Prof.Dr. Duy Phuoc TRAN**<br>Tokyo Inst. of Tech., Japan |
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| 15:05 – 15:30 | **Invited speaker 2 (IO-02):**<br>*Deciphering the actin structure-dependent preferential cooperative binding of cofilin*<br><br>**Assist.Prof.Dr. Kien Xuan NGO**<br>WPI-NanoLSI, Kanazawa Uni., Japan | **Invited speaker 7 (IO-07):**<br>*Biphasic reinforcement of nascent adhesions by vinculin*<br><br>**Assoc.Prof.Dr. Clemens Franz**<br>WPI Nano Life Science Institute, Kanazawa University, Japan | **Invited speaker 10 (IO-10):**<br>*Protein dynamics by the combination of high-speed atomic force microscopy and computational modeling*<br><br>**Assist.Prof.Dr. Holger FLECHSIG**<br>WPI-NanoLSI, Kanazawa Uni., Japan |
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| 15:30 – 16:00 | **Tea break and poster visiting** | | |
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| | **Chair: Assoc.Prof.Dr. Huy Quang TRAN**<br>**Co-chair: Assist.Prof.Dr. Kien Xuan NGO** | **Chair: Assoc.Prof.Dr. Satoshi ARAI**<br>**Co-chair:** | **Chair: Assoc.Prof.Dr. Yusuke MORIMOTO**<br>**Co-chair: Dr.Huong HA** |
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| 16:00 – 16:20 | **Oral talk 1 (OP-01)**<br>*Bioengineering and characterization of green-synthesized silver nanoparticles with anticancer activity against human breast cancer cells*<br><br>**Nilesh Rai,** Vibhav Gautam*<br>Inst. of Med. Sci., Banaras Hindu Uni., India | **Oral talk 14 (OP-14)**<br>*Investigation of polymer-based hydrogel in the management of diabetic wounds*<br><br>**Unnikrishnan B S,** Gopinath Packirisamy<br>Indian Inst. of Tech. Roorkee, India | **Oral talk 26 (OP-26)**<br>*Development of machine learning models for predicting antibiotic resistance in an intensive care unit of a Vietnamese hospital*<br><br>**An Dang Do**<br>Dep. of Comm. and Glob. Health, The Uni. of Tokyo, Japan |
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| 16:20 – 16:40 | **Oral talk 2 (OP-02)**<br>*Elucidating the process of pore formation by alpha-hemolysin on lipid membranes using high-speed Atomic Force Microscopy* | **Oral talk 15 (OP-15)**<br>*Dual light responsive chitosan nanocatalyst for photodynamic antibacterial therapy* | **Oral talk 27 (OP-27)**<br>*Threshold selection in three-class classification problems with clustered data: an application to the discrimination of glutamatergic neurons types* |

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| | **Ngan Thi Phuong Le[1,2],** Hanh Thi Thu Phan[1,2], Vuong Duong Le[1,2], Kien Xuan Ngo[3], Hoang Duc Nguyen[1,2]<br>[1,2]Cent. for Biosci. and Biotech., Uni. of Sci., Vietnam Nat. Uni., HCMC, Vietnam<br>[3]WPI-NanoLSI, Kanazawa Uni., Japan | **Nayanika Chakraborty[1,2],** Indrajt Roy[1], Hemant K. Gautam[2]<br>[1]Uni. of Delhi, India<br>[2]CSIR-Inst. of Genomics and Integrative Biol., India | **Duc-Khanh To[1]**, Gianfranco Adimari[2] , Monica Chiogna[3], Davide Risso[2]<br>[1]Fac. of Math. and Comp. Sci., Uni. of Sci. - Vietnam Nat. Uni., Ho Chi Minh city, Vietnam<br>[2]Depart. of Stat. Sci., Uni. of Padova, Padova, Italy<br>[3]Depart. of Stat. Sci. "Paolo Fortunati", Uni. of Bologna, Italy |
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| 16:40 – 17:00 | **Oral talk 3 (OP-03)**<br>*Nail polish - a simple and low-cost procedure for fabrication of paper-based microfluidic device*<br><br>**Thi Ngoc Diep Trinh[1]** and Nae Yoon Lee[2,*]<br>[1]Sch. of Appl. Chem., Tra Vinh Uni., Vietnam<br>[2]Gachon Uni., Korea | **Oral talk 16 (OP-16)**<br>*Use of functionalized magnetic nanoparticles for rapid PCR-based detection of Lactobacillus fermentum, a bacterial contaminant in ethanol fermentation*<br><br>**Eden Beth B. Asilo[1],** Francisco B. Elegado[2], Maria Teresa M. Perez[3], Lorele C. Trinidad[4], Bernadette C. Mendoza[5], Evangelyn C. Alocilja[6]<br>[1,2,3]Uni. of the Philippines Los Baños; [4]Nat. Inst. of Mol. Biol. and Biotech.; [5]Inst. of Biol. Sci., Uni. of the Philippines Los Baños;<br>[6]Michigan State Uni., USA | **Oral talk 28 (OP-28)**<br>*AutoEntangle: A groundbreaking insect surveillance system revolutionized by harnessing edge computing capabilities*<br><br>**Quan Minh Nguyen[1],** Vu Thanh Le[2], Minh Nhat Lai[3], Hien Bich Vo[4]<br>[1]Sch. of Electrical and Electronic Eng., Hanoi Uni. of Sci. and Tech., Vietnam<br>[2]Nat. Econ. Uni., Vietnam<br>[3]Sch. of Mech. Eng., Hanoi Uni. of Sci. and Tech., Vietnam<br>[4]Vietnamese-German Uni., Vietnam |
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| 17:00 - 17:20 | **Oral talk 4 (OP-4)**<br>*Combination of nanopipette-based non-thermal atmospheric pressure plasma and scanning ion conductance microscopy for investigating plasma-induced modification on cell membrane*<br><br>**Han Gia Nguyen[1],** Linhao Sun[2], Shinya Kumagai[3], Shinji Watanabe[2]<br>[1]Div. of Nano Life Sci.; [2]WPI-NanoLSI, Kanazawa Uni., Japan, [3]Meijo Uni., Japan | **Oral talk 17 (OP-17)**<br>*Establishment of multi-functional recombinant antibodies against tags, which adapts versatile biological applications*<br><br>**Quynh Thi-Huong Pham,** Yusuke Miyanari*<br>WPI-NanoLSI, Kanazawa Uni., Japan | **Oral talk 29 (OP-29)**<br>*In vitro study of flow effects on cellular and plasma proteins behavior*<br><br>**Dang Phu-Hai Nguyen[1,2],** Khon Huynh[1,2]<br>[1]Sch. of Biomed. Eng., Int. Uni., HCMC, Vietnam<br>[2]Vietnam Nat. Uni., HCMC, Vietnam |
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| 17:20 – 17:40 | **Oral talk 5 (OP-05)**<br>*Drug delivery systems based on electrospun PLA nanofibers with* | **Oral talk 18 (OP-18)**<br>*Investigation of the effect of ATP/ADP for formation of 2-Cys* | |

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| | *core/sheath and blended structures*<br><br>**Thuy Thi Thu Nguyen,** Le Thi Le, Hue Thi Nguyen, Huy Quang Tran Phenikaa Uni. Nano Inst., Vietnam | *peroxiredoxin (Prx2) high molecular weight complex*<br><br>**Tran Ngoc Trang[1]**, Konno Hiroki[2] [1]Grad. Sch. of Front. Sci. Init. [2]WPI-NanoLSI, Kanazawa Uni., Japan | |
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| 17:40 – 18:00 | **Oral talk 6 (OP-06)**<br>*Direct observation of the interactions of cyclase-associated protein with actin filaments by high-speed atomic force microscopy*<br><br>**Phuong Doan N Nguyen[1],** Hiroshi Abe[2], Shoichiro Ono[3], Noriyuki Kodera[4]<br>[1]Grad.Sch. NanoLS., Kanazawa Uni., [2]Dept. Biol., Chiba Uni., [3]Dept. Pathol. & Cell Biol., Emory Uni., [4]WPI-NanoLSI, Kanazawa Uni., Japan | | |
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| 18:00 - 19:00 | Dinner at ICISE | | |
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| 19:00 | Returning to Seagull Hotel by shutter Buses | | |
| **Monday, 18th September, 2023** | | | |
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| 8:00 – 8:30 | Moving to ICISE from Seagull Hotel by shuttle Buses | | |
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| **Plenary/keynote talks – Main Hall**<br>**Chair: Prof.Dr. Gopinath PACKIRISAMY**<br>**Co-chair: Assoc. Prof. Yusuke MIYANARI** | | | |
| | | | |
| 9:00 – 9:40 | **Plenary lecture 3 (PO-03):**<br>*Artificial cell reactor technology* | | **Prof.Dr. Hiroyuki NOJI**<br>President – The Biophys. Soc. of Japan<br>Grad. Sch. of Eng., The Uni. of Tokyo, Japan |
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| 9:40 – 10:10 | **Keynote speaker 4 (KO-04)**:<br>*Insights into the mechanism of ATP-driven rotary motors from direct torque measurement* | | **Prof.Dr. Takayuki NISHIZAKA**<br>Vice president – Asian Biophys. Assoc.<br>Gakushuin Uni., Japan |
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| 10:10 – 10:40 | **Keynote speaker 5 (KO-05)**:<br>*Subcellular thermometry and nanoheating toward thermal cell engineering* | | **Assoc.Prof.Dr. Satoshi ARAI**<br>WPI-NanoLSI, Kanazawa Uni., Japan |
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| 10:40 - 11:00 | Coffee break and poster visiting | | |

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|---|---|---|
| **Chair: Prof.Dr. Hiroyuki NOJI**<br>**Co-chair: Prof.Dr. Hemant K Gautam** | | |
| 11:00 – 11:30 | **Keynote speaker 6 (KO-06):**<br>*Design and development of nanofibers for biomedical applications* | **Prof.Dr. Gopinath PACKIRISAMY**<br>Indian Inst. of Tech. (IIT) Roorkee, India |
| 11:30 – 12:00 | **Keynote speaker 7 (KO-07):**<br>*Single-molecule visualization of Ca2+/calmodulin-dependent protein kinase II by HS-AFM* | **Prof.Dr. Mikihiro SHIBATA**<br>WPI-NanoLSI, Kanazawa Uni., Japan |
| 12:00 – 12:30 | **Keynote speaker 8 (KO-08):**<br>*Advancements in highly sensitive detection: from nanomaterial labels to cost-effective platforms for real-world applications* | **Assoc.Prof.Dr. Werasak SURAREUNGCHAI**<br>King Mongkut's Uni. of Tech. Thonburi; Anal. Sci. and Nat. Doping Test Inst. Mahidol Uni., Thailand |
| 12:30 – 13:30 | Lunch break | *ICISE, Quy Nhon City* |
| 13:30 – 14:00 | Poster presentation | |
| **Keynote talks – Main Hall (cont.)** | | |
| **Chair: Prof. Takayuki NISHIZAKA**<br>**Co-chair: Assist. Prof.Dr. Cam Ha TRAN** | | |
| 14:00 – 14:30 | **Keynote speaker 9 (KO-09):**<br>*Multi-functional composite nanomaterials for theranostics of diseases* | **Assoc.Prof.Dr. Hang T. TA**<br>Griffith Uni., Australia |
| 14:30 – 15:00 | **Keynote speaker 10 (KO-10):**<br>*Epigenetic regulation of gene expression* | **Assoc.Prof.Dr. Yusuke MIYANARI**<br>WPI-NanoLSI, Kanazawa Uni., Japan |

| **Concurrent sessions** | | | |
|---|---|---|---|
| | **Nano Biotechnology - Main Hall** | **Biosensor – Meeting Room 1** | **Computation – Meeting Room 2** |
| | **Chair: Assoc.Prof.Dr. Huy Quang TRAN**<br>**Co-chair: Assist.Prof.Dr. Kien Xuan NGO** | **Chair: Assoc.Prof.Dr. Satoshi ARAI**<br>**Co-chair: Assoc.Prof.Dr. Clemens M. FRANZ** | **Chair: Assist.Prof.Dr. Duy Phuoc TRAN**<br>**Co-chair: Assist.Prof.Dr. Takashi SUMIKAMA** |
| 15:15 – 15:40 | **Invited speaker 3 (IO-03):**<br>*Structural dynamics of intrinsically disordered proteins and its assembly process* | **Invited speaker 8 (IO-08):**<br>*Genetically encoded fluorescence lifetime biosensors for quantitative imaging of metabolites in live cells* | **Invited speaker 11 (IO-11):**<br>*AFM image computations by force calculation and combined studies of AFM and MD simulations* |

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| | **Assoc.Prof.Dr. Hiroki KONNO**<br>WPI-NanoLSI, Kanazawa Uni., Japan | **Assist.Prof.Dr. Cong Quang VU**<br>WPI-NanoLSI, Kanazawa Uni., Japan | **Assist.Prof.Dr. Takashi SUMIKAMA**<br>WPI-NanoLSI, Kanazawa Uni., Japan |
| 15:40 – 16:05 | **Invited speaker 4 (IO-04)**<br>*Targeting α-synuclein inclusions by GQDs in an MSA model*<br><br>**Prof.Dr. Małgorzata KUJAWSKA**<br>Poznan Uni. of Med. Sci., Poland | **Oral talk 19 (OP-19):**<br>*The synthesis and functional assembly of T7 replisome machinery in vitro system*<br><br>**Huong Thi Bui[1,2,3*],** Ngoc Huong Hoang[4], Quynh Huong Thi Bui[4], Nguyet Anh Thi Bui[3], Dung Ngoc Hoang[3], Nhi Van Pham[5], Tra Huong Thi Nguyen[1], Pauline van Nies[2], Ilja Westerlaken[2] and Christophe Danelon[2]<br>[1]Vietnam Nat. Inst. of Agri. Eng. and Post-Harvest Tech.;<br>[2]Delft Uni. of Tech., the Netherlands; [3]Nhat Lan Green Biotech. Com.; [4]Vietnam Nat. Uni.; [5]Vietnam Acad. of Agri. | **Oral talk 30 (OP-30):**<br>*Plasma cell-free RNA profiling of Vietnamese Alzheimer's patients reveals a linkage with chronic inflammation and apoptosis: a pilot study*<br><br>Thien Hoang Minh Cao[*1], Anh Phuc Hoang Le[*1], Tai Tien Tran[2], Vy Kim Huynh[1], Bao Hoai Pham[1], Thao Mai Le[1], Hang Nguyen[1], Quang Lam Nguyen[1], Thang Cong Tran[4], Trang Mai Tong[3], The H. N. Than[3], Tran T. T. Nguyen[3], **Huong T. T. Ha[1,#]**<br>[1]Int. Uni., Vietnam Nat. Uni., HCMC; [2]Pham Ngoc Thach Uni. of Med., [3]Uni. Med. Cent, HCMC; [4]April 30th Hosp., HCMC, Vietnam |
| 16:05 – 17:00 | **Tea break and poster visiting** | | |
| | **Chair: Prof.Dr. Małgorzata KUJAWSKA**<br>**Co-chair: Assoc.Prof.Dr. Hiroki KONNO** | | |
| 17:00 – 17:20 | **Oral talk 7 (OP-07):**<br>*Evaluation of electrical conductivity, antioxidant and antimicrobial activity of ZnO nano particles and Catharanthus roseus leaf extracts against organisms causing dandruff*<br><br>**Roselin Polugari, Mansi Jain**<br>St. Francis Col. for Women, India | **Oral talk 20 (OP-20):**<br>*Artificial synaptic vesicle for optical control of neurotransmitter with high spatiotemporal resolution*<br><br>**Takeru Yamazaki,** Satya Sarker, Yusuke Kurita, Kayoko Nomura, Satoshi Arai<br>WPI-NanoLSI, Kanazawa Uni., Japan | **Oral talk 31 (OP-31):**<br>*Revealing the heterogeneity of plasma protein and cognitive decline trajectory among Mild Cognitive Impairment patients by clustering of brain atrophy features*<br><br>**My Nguyen[1,2],** Bao Pham[2,3], Toi Vo[2,3], Huong Ha[2,3]<br>[1]Fact. of Biol. Biotech., Uni. of Sci., [2]Vietnam Nat. Uni. HCMC; [3]Sch. of Biomed. Eng., Int. Uni., HCMC, Vietnam |
| 17:20 – 17:40 | **Oral talk 8 (OP-08):** | **Oral talk 21 (OP-21)**<br>*Investigating the post-harvest preservation of mango using* | **Oral talk 32 (OP-32):** |

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| | *In vitro study of microbial – iron nanocomposite in metal removal and impact on plant growth*<br><br>**Gayatri. V** and Shailaja Raj M<br>St. Francis Col. for Women, India | *nanocellulose and chitosan in Vietnam*<br><br>**Dương Thi Thuy Nguyen,** Ngoan Thi Tran, Anh Tuan Pham, Hoa Thanh Nguyen<br>Sch. of Chem. and Life Sci., Hanoi Uni. of Sci. and Tech., Vietnam | *Interaction of curcumin molecule with fullerene material by simulation method*<br><br>**Phuc Vu Le,** Vi Toan Lam, Thu Hanh Tran Thi<br>Computational Phys. Lab., Appl. Sci. Fact., HCMC Uni. of Tech., VNU, Vietnam. |
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| 17:40 – 18:00 | **Oral talk 9 (OP-09):**<br>*Synthesis of silver nanoparticles by exopolysaccharide producing Levilactobacillus brevis*<br><br>**Suman Kondamudi,** Aruna B<br>St. Francis Col. for Women, India | **Oral talk 22 (OP-22):**<br>*Application in cancer cell monitoring and point-of-care diagnostics using microfluidic devices*<br><br>**Tien-Anh Nguyen[1,*],** Van Toan Nguyen, and Van Nhat Pham[2,*]<br>[1]Le Quy Don Tech. Uni., [2]Uni. of Sci. and Tech. of Hanoi, VAST, Vietnam | **Oral talk 33 (OP-33):**<br>*Investigation of the binding properties of several ligands with the main protease of SARS-CoV-2*<br><br>**Tao T. Nguyen,** Hien T.T. Lai, and Toan T. Nguyen[*]<br>Key Lab. For Multiscale Sim. of Comp. Sys., Fact. of Phys., Uni. of Sci., Vietnam |
| | | | |
| 18:00 – 18:20 | **Oral talk 10 (OP-10):**<br>*Developing strategies for intracellular exploration by scanning probe microscopy*<br><br>**You-Rong Lin,** Clemens Franz<br>WPI-NanoLSI, Kanazawa Uni., Japan | | |
| | | | |
| 18:30 – 19:00 | Cocktail banquet<br>Introduction of "Vietnamese Biophysical Society (VBS)" | | |
| | | | |
| 19:00 – 21:00 | GALA dinner | | |
| | | | |
| 21:00 ~ | Returning to Seagull Hotel by shutter Buses | | |
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## Tuesday, 19th September, 2023

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| 8:00 ~ 8:30 | Moving to ICISE from Seagull Hotel by shuttle Buses |
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| **Keynote talks – Main Hall** | |
| **Chair: Assoc.Prof. Nguyen Bao Quoc**<br>**Co-chair: Hien Bich VO** | |
| | |
| 9:00 – 9:30 | **Keynote speaker 11 (KO-11):** |

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|---|---|---|
| | *Engineered nanosystem for white light activated antibacterial photodynamic therapy* | **Prof.Dr. Hemant K. GAUTAM**<br>Inst. of Gen. and Integrative. Biol., New Delhi, India |
| | | |
| 9:30 – 10:00 | **Keynote speaker 12 (KO-12):**<br>*Signal transduction in unicellular and multicellular stages of Dictyostelium* | **Assoc.Prof.Dr. Yusuke MORIMOTO**<br>Fact. of Com. Sci. and Sys. Eng., Kyushu Inst. of Tech., Japan |
| | | |
| 10:00 – 10:20 | Tea break and poster visiting | |
| | | |
| **Concurrent sessions** | | |
| | **Nano Biotechnology - Main Hall** | **Biosensor– Meeting Room 1** |
| | **Chair: Assoc.Prof.Dr. Hang T. TA**<br>**Co-chair: Assoc.Prof.Dr. Hoang Duc NGUYEN** | **Chair: Dr. Khon Chan HUYNH**<br>**Co-chair: Assist.Prof.Dr. Cong Quang VU** |
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| 10:20 – 10:45 | **Invited speaker 5 (IO-05):**<br>*Application of silver nanoparticles (AgNPs) for management of white grubs (Holotrichia spp.) in sugarcane crop*<br><br>**Prof.Dr.**<br>**Shailendra Singh GAURAV**<br>Chaudhary Charan Singh Uni., India | **Oral talk 23 (OP-23):**<br>*Investigating the post-harvest preservation of Bananas using nanocellulose and chitosan in Vietnam*<br><br>Ngoan Thi Tran, Duong Thi Thuy Nguyen, Anh Tuan Pham**, Hoa Thanh Nguyen**<br>Sch. of Chem. and Life Sci., Hanoi Uni. of Sci. and Tech., Vietnam |
| | | |
| 10:45 – 11:05 | **Oral talk 11 (OP-11):**<br>*High-speed atomic force microscopy reveals dynamic unfolding of the laminin coiled-coil domain*<br><br>**Lucky Akter,** Holger Flechsig, and Clemens M Franz<br>WPI-NanoLSI, Kanazawa Uni., Japan | **Oral talk 24 (OP-24):**<br>*Fibroblast growth factor 2-incorporated carboxymethyl cellulose nanoparticles for burned skin tissue repair and regeneration*<br><br>**Khanh-Thien Le[1,2,3],** Cong-Thuan Nguyen[1,2], Le-Giang Thi Nguyen[1,2], Thuoc Linh Tran[1,2,3], Hieu Tran-Van[1,2,3]<br>[1,2,3]Vietnam Nat. Uni., HCMC |
| | | |
| 11:05 – 11:25 | **Oral talk 12 (OP-12):**<br>*Anodic aluminum oxide (AAO) template guided plasmonic nanoarray fabrication and their application*<br><br>**Nguyen Nhat Nam***<br>Biotech. Cent., Sch. of Agri. and Aquact., Tra Vinh Uni., Vietnam | **Oral talk 25 (OP-25):**<br>*Biomaterial actuator of M13 bacteriophage in tunable gap plasmonic color film for diagnosing lung cancer*<br><br>**Thanh Mien Nguyen[1],** Gyeong-Ha Bak[2], You Hwan Kim[2], Eun-Jung Choi[1], Jin-Woo Oh[1,2]<br>[1,2]Pusan Nat. Uni., Rep. of Korea |
| | | |
| 11:25 – 11:50 | **Oral talk 13 (OP-13):**<br>*Enhancement of antidandruff activity of shampoo by biosynthesized silver nanoparticles using lemon peel extract against Malassezia furfur*<br><br>**Mamatha P** and Ramakrishna R<br>Vaageswari Inst. of Pharm. Sci., India | |
| | | |

| Closing ceremony – Main Hall | | |
|---|---|---|
| **Chair: Assoc.Prof.Dr. Quoc Bao NGUYEN**<br>**Co-chair: Assist.Prof.Dr. Kien Xuan NGO** | | |
| 11:50 – 12:30 | **Closing ceremony – Main Hall**<br>+ Best oral and poster prize for students<br>+ IUPAB and symposium bursary awards | |
| | | |
| 12:30 – 13:30 | Lunch | |
| | | |
| 13:30 – 16:00 | Excursion in Quy Nhon, Binh Dinh for delegates<br>- Eo Gio | |
| | | |
| 16:00 – 17:00 | Pick up delegates to Phu Cat Airport, Binh Dinh province, Vietnam | |

# Plenary Lectures

# In silico study of Covid-19

Mai Suan Li[1]

[1] Institute of Physics, Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland

[2] Institute for Computational Sciences and Technology, Quang Trung Software City, Tan Chanh Hiep Ward, District 12, HoChi Minh City, Vietnam.

*Corresponding author's email masli@ifpan.edu.pl*

**Abstract:** The outbreak of a new coronavirus SARS-CoV-2 (severe acute respiratory syndrome–coronavirus 2) has caused a global COVID-19 (coronavirus disease 2019) pandemic, resulting in millions of infections and deaths around the world. Through unprecedented scientific endeavors, severalvaccines, drugs and antibodies have been developed and are widely used, but the fight against COVID- 19 continues as more and more variants of concern such as Delta and Omicron emerge. To understand the side effects caused by vaccines and therapeutic agents, and to develop more effective treatments, a deeper understanding of the molecular interactions of SARS-CoV-2 with them and human cells is required. In this talk, advances in combating COVID-19 using computational methods will be discussed.We will focus on the following problems:

1. Binding of the spike protein to human angiotensin-converting enzyme 2 (ACE2) before enteringthe cell for replication: Binding free energy and free energy landscape.
2. Interactions of antibodies with the spike protein of SARS-CoV-2.
3. SARS-CoV-2 non-structural protein 1 can stall mRNA translation in host ribosomes.

***Keywords**: Covid-19, SARS-CoV-2, Binding free energy landscape, mRNA translation, Steered molecular dynamics*

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**Position:** Professor

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# Encoding and Decoding of Molecular Information in Distributed Cellular Systemswith Feedback Control

Madan Rao[1]

[1]National Centre for Biological Sciences-TIFR, Bangalore, India

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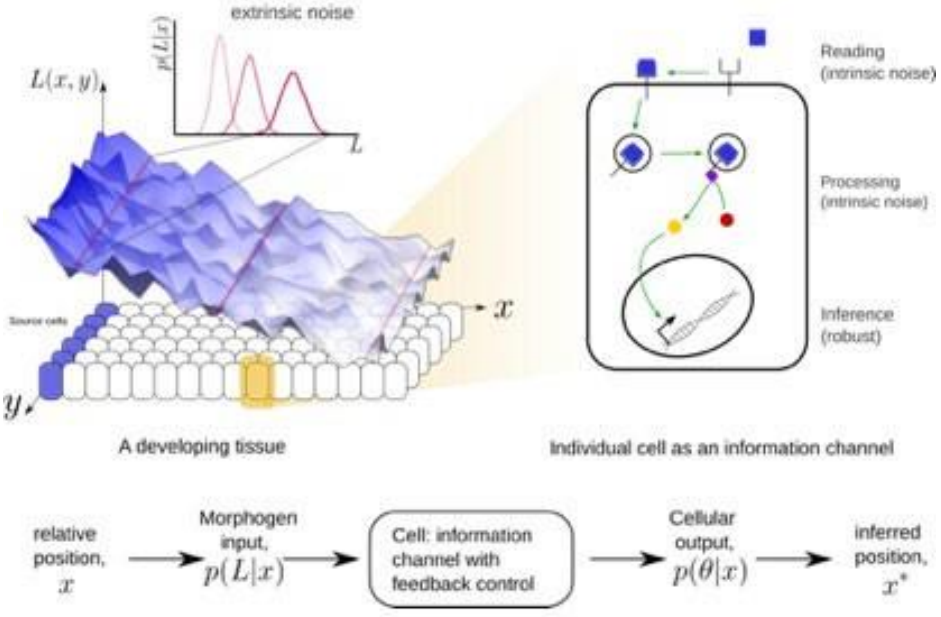
**Abstract:** It is often useful to think about Cells and Tissues as Distributed Computing Systems with Feedback Control, especially in the context of the processing of noisy molecular information. I will illustrate this in two parts. In the first, I will talk about cellular compartmentalisation and receptor promiscuity as a strategy for accurate inference of position during Morphogenesis. In the second, I will discuss the synthesis of a complex Glycan code in the Golgi cisternae, and how cisternal number and enzyme promiscuity achieves the target distribution with high fidelity.




## References

Krishnan S Iyer, Chaitra Prabhakara, Satyajit Mayor and Madan Rao, Cellular compartmentalisation andreceptor promiscuity as a strategy for accurate and robust inference of position during morphogenesis, eLife 12:e79257 (2023).

**Speaker:** Madan Rao

**Email:** rao.madan@gmail.com

**Position:** Senior Professor

**Affiliation:** National Centre for Biological Sciences-TIFR, Bangalore

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**Short biography**

Madan Rao is a theoretical physicist and a Senior Professor at the Simons Centre for the Study of Living Machines, National Centre for Biological Sciences (TIFR), Bangalore. He received his Ph.D from Indian Institute of Science, Bangalore in 1989 and post-doctoral training at Simon Fraser University, Vancouver. Subsequently, he held positions at the Institute of Mathematical Sciences, Chennai and Raman Research Institute, Bangalore. Rao has contributed significantly to the field of Active Matter from its inception, in particular its applications to cellular and tissue biophysics. His research has helped unearth new physico-chemical principles at work at the cell surface. He has received many awards in India, including the Shanti Swarup Bhatnagar Award in Physics. He was the President of the Indian Biophysical Society from 2019-2023.

# Artificial cell reactor technology

Hiroyuki Noji[1]

[1]University of Tokyo

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**Abstract:** Since we demonstrated the single-molecule enzymatic assay by micro-compartmentalization[1] (termed digital bioassay[2]), we have been pursuing the integration of complex biosystems on femtoliter reactor systems intending to realize more functional and autonomous microsystems, 'autonomous artificial cell reactors'. We have been aiming to reconstruct cell systems that grow autonomously by taking a bottom-up approach. For this purpose, we developed a cell-free gene expression system from a single molecule template DNA (digital gene expression) on FRAD device and demonstrated a highly accurate screening method to obtain activity-enhanced enzyme sequences with a high enrichment factor, ten thousand[3]. We also implemented cell-free genome replisome termed RCR (reconstituted cycled replication) into FRAD or water-in-emulsion[4]. Currently, we are pursuing the possibility to use microdroplets in aqueous two-phase systems (ATPAS) as permeable and dynamic cell reactors[5]. We willintroduce current findings on self-growing artificial cell reactors driven by internal DNA/RNA replication activity and discuss the perspectives of autonomous artificial cell reactor technology.

References

1 Rondelez, Y. et al. Microfabricated arrays of femtoliter chambers allow single molecule enzymology.Nat Biotechnol 23, 361-365 (2005).
2 Noji, H., Minagawa, Y. & Ueno, H. Enzyme-based digital bioassay technology - key strategies andfuture perspectives. Lab Chip 22, 3092-3109 (2022).
3 Zhang, Y. et al. Accurate high-throughput screening based on digital protein synthesis in a massivelyparallel femtoliter droplet array. Sci Adv 5, eaav8185 (2019).
4 Ueno, H. et al. Amplification of over 100 kbp DNA from Single Template Molecules in FemtoliterDroplets. ACS Synth Biol 10, 2179-2186 (2021).
5 Minagawa, Y., Nakata, S., Date, M., Ii, Y. & Noji, H. On-Chip Enrichment System for Digital BioassayBased on Aqueous Two-Phase System. Acs Nano (2022).

**Speaker:** Hiroyuki Noji
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**Position:** Professor
**Affiliation:** University of Tokyo

**Biography**:

- 1997 PhD, Tokyo Institute of Technology
- 1998-2000 Postdoctoral researcher, CREST team 13, JST
- 2000-2001 PRESTO researcher, PRESTO, JST
- 2001-2005 Associate Professor, Institute of Technology, University of Tokyo
- 2005-2010 Professor, Institute of Industrial Science, Osaka University
- 2010-present Professor, Grad. Sch. of Eng. University of Tokyo

# Keynote Lectures

# High-speed atomic force microscopy for studying dynamic behaviours of biomolecules

Noriyuki Kodera[1]

[1] WPI-NanoLSI, Kanazawa University, Japan

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**Abstract:** High-speed atomic force microscopy (HS-AFM) is a unique microscopy that allows direct real-time visualization of biomolecules in action under near-physiological conditions, without any chemical labelling. Typically, the temporal resolution is sub-100 ms, and the spatial resolution is 2–3 nmin the lateral direction and ~0.1 nm in the vertical direction[1]. A wide range of biomolecular systems and their dynamic processes have been studied by HS-AFM, providing deep mechanistic insights into how biomolecules function. Notably, HS-AFM is particularly powerful in visualizing large and flexible biomolecular systems (**Fig. 1**)[2-4], which conventional structural biology methods are unable to visualize.In the presentation, after overviewing the principles and performance of HS-AFM, AFM images showing dynamic behaviours of biomolecules will be shown. In addition, our recent efforts to improve the speed performance of HS-AFM will be discussed[5].

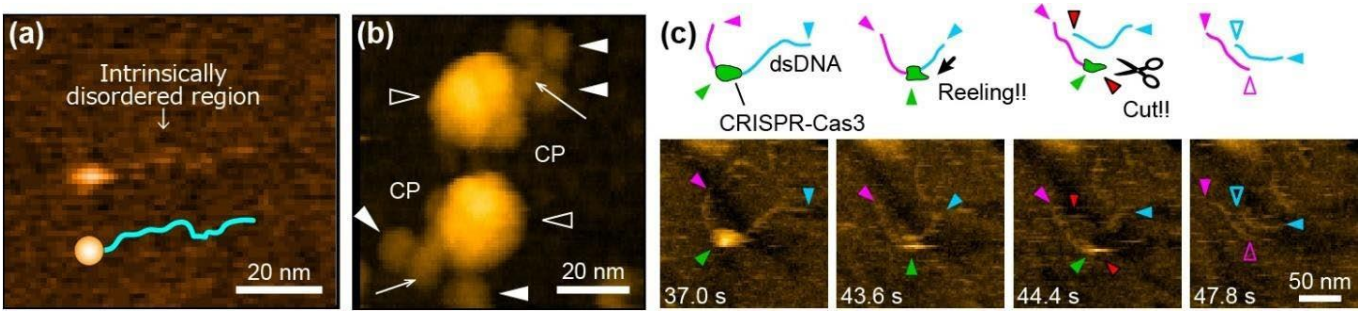


**Fig. 1 Typical HS-AFM images showing dynamic behaviours of biological molecules.** (a) Flexible motion of intrinsically disordered region of a protein[2]. (b) Assembling of translation factors (EF2, white closed arrowheads) on the ribosomal stalk complex (white arrow) of ribosomes (white open arrowheads)[3].

(c) DNA editing by CRISPR-Cas3 with helicase and nuclease activities.

**References**


1. Ando, T., Uchihashi, T., Kodera, N. 2013. High-speed AFM and applications to biomolecularsystems. Anuu. Rev. Biophys., 42, 393-414.
2. Kodera, N., Noshiro, D., Dora, S. K., …, Longhi, S., Ando T. 2021. Structural and dynamics analysis of intrinsically disordered proteins by high-speed atomic force microscopy. Nat. Nanotechnol., 16, 181-189.
3. Imai, H., Uchiumi, T., and Kodera, N. 2020. Direct visualization of translational GTPase factor pool formed around the archaeal ribosomal P-stalk by high-speed AFM. PNAS, 117, 32386-32394.
4. Yoshimi, K., Takeshita, K., Kodera, N., …, Mashimo, T. 2022. Dynamic mechanisms of CRISPRinterference by *Escherichia coli* CRISPR-Cas3. Nat. Commun., 13, 4917.
5. Umeda, K., McArthur, S. J., Kodera, N. 2023. Spatiotemporal resolution in high-speed atomic force microscopy for studying biological macromolecules in action. Microscopy, 72, 151-161.



**Speaker:** Noriyuki Kodera

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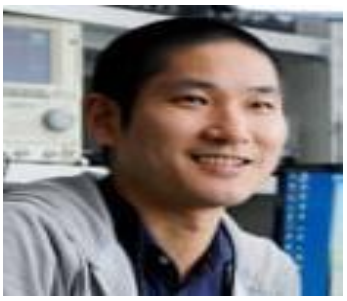
**Position:** Professor

**Affiliation:** WPI-NanoLSI, Kanazawa University

Biography:

| | |
|---|---|
| 2005 | Ph.D. Kanazawa University |
| 2010-2011 | Assist. Prof. in Kanazawa University |
| 2011-2018 | Assoc. Prof. in Kanazawa University |
| 2018- | Prof. in Kanazawa University |

# Machine learning application to biomedicine research at the VNU Key Laboratoryfor Multiscale simulation of Complex Systems

Nguyen Tien Cuong[1], Toan T Nguyen[1,2]

[1] Faculty of Physics, University of Science, Vietnam National University

[2]Key Laboratory for Multiscale Simulation of Complex Systems, University of Science, Vietnam National University

*Corresponding author's email* toannt@hus.edu.vn

**Abstract:** In this talk, several applications of machine learning methods (computer vision, graph neuralnetworks and variable autoencoders) to various problems in computational biomedicine is presented. In the context of drug design, protein interactions, biophysical simulations. These methods offer complementary and sometime advantageous analyses to existing bioinformatic and biophysical approaches. Specific examples are researches on covid-19, Gout disease, morphine-based analgesic compounds being done at the VNU Key Laboratory for Multiscale simulation of Complex Systems, VNU University of Science, Hanoi, Vietnam.

***Keywords****: Computational biomedicine, machine learning, covid-19, biomaterials, morphine-based analgesic*

**Speaker:** Toan The Nguyen

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**Position:** Professor

**Affiliation:** [1] Faculty of Physics, University of Science, Vietnam National; [2]Key Laboratory for Multiscale Simulation of Complex Systems, University of Science, Vietnam National University

# Impedimetric sensing for (bio)matter recognition

Congo Tak Shing CHING[1]

[1] Graduate Institute of Biomedical Engineering, National Chung Hsing University, Taiwan

*Corresponding author's email* tsching@nchu.edu.tw

**Abstract:** Nowadays, electric potential, current, impedance, capacitance, etc. play an important role in our daily life, and these electrical parameters can actually have many applications. For example, ElectricalImpedance Spectroscopy (EIS) has been widely used for the characterization of (bio)matters. There are lots of EIS applications and the speaker cites his own research experiences in applying EIS in E. coli. identification and quantification, as well as in microplastics identification.

In my E. coli. identification and quantification study, a biorecognition-element-free interdigitated microelectrode (IDμE) sensor is designed and developed with good reliability and affordability. Results show that the designed sensor can identify E. coli with good selectivity using an impedance andcapacitance of 7.69 MHz (Figure 1). At its optimum impedance of 1.3 kHz, the IDμE sensor can reliablyquantify E. coli (Figure 2) in a range of measurement ($10^{3.2}$~$10^{6}$ cfu/mL), linearity ($R^2$ = 0.97), sensitivity (18.15 kΩ/log (cfu/mL)), and limit of detection ($10^{3.2}$ cfu/mL). Therefore, the IDμE sensor developed possesses high potential for industrial and clinical applications.

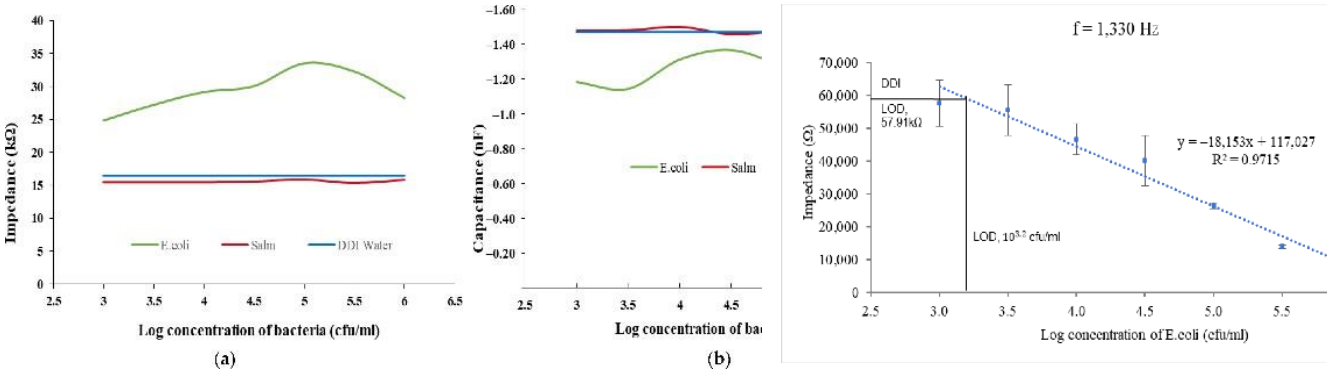


Figure 1. Differences in the (a) impedance and (b) capacitance between E. coli and Salmonella samples with NC at the characteristic frequency of 7.69 MHz




Figure 2. Calibration curves of E. coliimpedance at different sample concentrations tested at 1.3 kHz.

In my microplastics identification study, EIS measurements using IDμE confirmed the accurate identification of microplastic materials in question, by using self-normalized ratio between two characteristic frequencies of 7 MHz and 8.9 MHz, Z'f=7 MHz/Z'f=8.9 MHz (Figure 3). 3-kNN classifier built with the ratio Z'f=7 MHz/Z'f=8.9 MHz, and Z'f=8 MHz/Z'f=8.9 MHz, demonstrates accuracy upto 90% for the identification of single or both microplastic types in samples (Figure 4). These results confirm impedance spectroscopy, permittingrapid identification of microplastic without labelling and skillful techniques, as a potential rapid sensor.

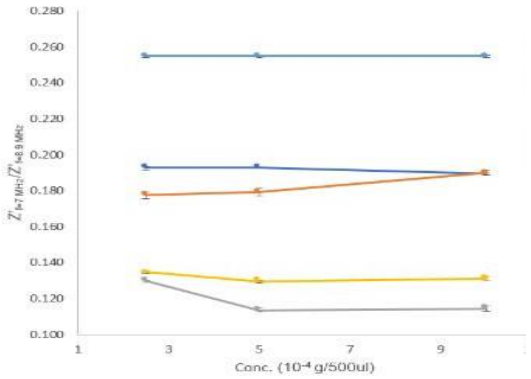


Figure 3. Microplastics identification.

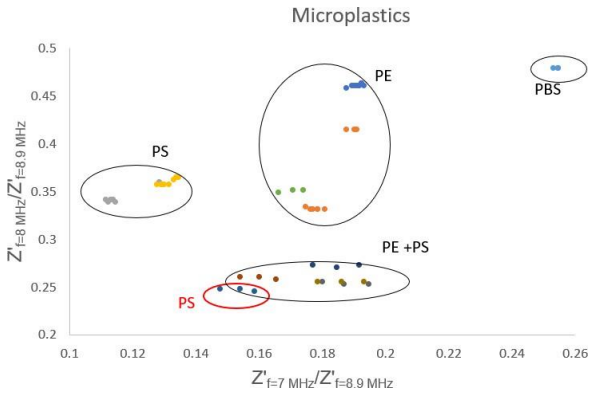


Figure 4. 3-kNN algorithm for microplastics classification

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**Position:** Professor

**Affiliation:** Graduate Institute of Biomedical Engineering, National Chung Hsing University, Taiwan

Professor Congo Tak Shing Ching obtained his BSc (Hons) in Prosthetics and Orthotics with first class honor from The Hong Kong Polytechnic University (PolyU) in 1999 and received his MPhil in Biomedical Engineering from PolyU in 2002. He went to gain a PhD in Bioengineering from the University of Strathclyde, Glasgow, UK, in 2005. His main interests in research are in the area of biomedical instrumentation design, biosensors, tissue bioimpedance, biomedical electronics, biomedical optoelectronic, AIoT healthcare, assistive healthcare technologies, as well as non-invasive and transdermal metabolites/biomarkers extraction and drugs delivery. He is now serving as a professor and director at the Graduate Institute of Biomedical Engineering, National Chung Hsing University, Taiwan.

# INSIGHTS INTO THE MECHANISM OF ATP-DRIVEN ROTARY MOTORSFROM DIRECT TORQUE MEASUREMENT

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**Abstract:** Motor proteins are molecular machines that convert chemical energy into mechanical work. Inaddition to existing studies performed on the linear motors found in eukaryotic cells, researchers in biophysics have also focused on rotary motors such as bacterial flagellar motor (BFM) and F1-ATPase. The research group including Nishizaka contributed to correlate all chemical states to specific mechanicalevents by visualizing single chemical reactions under the advanced optical microscope (Nishizaka *et. al.* 2004, *Nat. Struct. Mol. Biol.*). From the structural point of view, conformational changes of β-subunit (Masaike, Nishizaka 2008, *Nat. Struct. Mol. Biol.*; Sugawa, …, Nishizaka 2016, *Proc. Natl. Acad. Sci. USA*) and behaviours of the γ-shaft (Sugawa, …, Nishizaka 2011, *Biophys. J.*; Naito, …, Nishizaka 2019, *Sci. Rep.*; Hasimoto, …, Nishizaka 2023, *Biophys J.*) were also addressed through a series of microscopy techniques at the single molecular level. Recent studies showed that there exists another ATP-driven protein motor in life: the rotary machinery that rotates archaeal flagella (archaella). None of the archaellar motility structure is homologous to any BMF proteins. Rotation speed, stepwise movement, andvariable directionality of the motor of Halobacterium salinarum were described in previous studies (Kinosita, …, Nishizaka 2016, *Nature Microbiol.*) We further presented recent experimental work discerning the molecular mechanism underlying how the archaellar motor protein FlaI drives rotation by generation of motor torque (Iwata, …, Nishizaka 2019, *Commun. Biol.*; Nishizaka *et. al.* 2019, *Biophys. Rev.*). In combination, those studies found that rotation slows as the viscous drag of markers increases, buttorque remains constant at 160 pN·nm independent of rotation speed. Unexpectedly, the estimated work done in a single rotation is twice the expected energy that would come from hydrolysis of six ATP molecules in the FlaI hexamer. To reconcile the apparent contradiction, a new and general model for the mechanism of ATP-driven rotary motors will be discussed.

***Keywords****: Advanced optical microscopes, Motor proteins, ATP cleavage angle of F1-ATPase*

**Speaker:** Takayuki Nishizaka

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**Position:** Professor

**Affiliation:** Department of Physics, Gakushuin University, 1-5-1 Mejiro, Toshima-ku, Tokyo 171-8588, Japan

# Subcellular Thermometry and Nanoheating toward Thermal Cell Engineering

Satoshi Arai[1]

[1] WPI-NanoLSI, Kanazawa University

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**Abstract:** Microscale temperature is of fundamental importance in cellular systems. However, measuringand controlling temperature at the subcellular scale remains a challenge. Over the past few years, we havedeveloped microscopic tools enabling subcellular thermometry and nanoheating through the chemistry approach. For thermometry, we generated a palette of fluorescent thermometers that allow the temperature increase at the organelle to be read out as detectable fluorescent signals such as fluorescence intensity and lifetime. Note that the palette includes representative organelles such as mitochondria, endoplasmic reticulum, plasma membranes, nucleus, Golgi, lysosome and lipid droplets. Using organelle targeted fluorescence thermometers with Fluorescence Lifetime Imaging Microscopy (FLIM), we found that mitochondria could serve as a nanoscale heat source in thermogenic cells such as brown adipocytes[1]. In addition, we created a nanoheater (nanoHT) in which a photothermal dye and a thermometer dye were embedded in the polymeric nanoparticle. The embedded thermometer makes it possible to create a quantitative heat spot with concurrent thermometry. Using nanoHT, we further demonstrated the rapid induction of cell death in cancer cells and the thermodynamic manipulation of muscle contraction[2].

***References**:*

1) Liu, X.; Yamazaki, T.; Kwon, H. Y.; Arai, S.; Chang, Y. T. A Palette of Site-Specific OrganelleFluorescent Thermometers. *Mater. Today Bio* 2022, 16, 100405.

2) Ferdinandus; Suzuki, M.; Vu, C. Q.; Harada, Y.; Sarker, S. R.; Ishiwata, S.; Kitaguchi, T.; Arai, S. Modulation of Local Cellular Activities Using a Photothermal Dye-Based Subcellular-Sized Heat Spot. *ACS Nano* 2022, 16, 9004–9018.

***Keywords**: fluorescence lifetime microscopy (FLIM), thermometry, nano-heater, thermogenesis*

**Speaker:** Satoshi Arai

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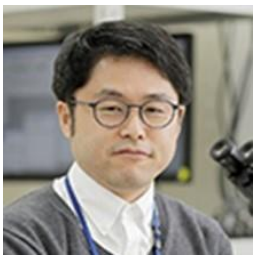
**Position:** Associate Professor

**Affiliation:** WPI-NanoLSI, Kanazawa University



# Design and development of nanofibers for biomedical applications

Gopinath Packirisamy[1]

[1]Department of Biosciences and Bioengineering, Indian Institute of Technology (IIT) Roorkee, Roorkee-247667, Uttarakhand. India

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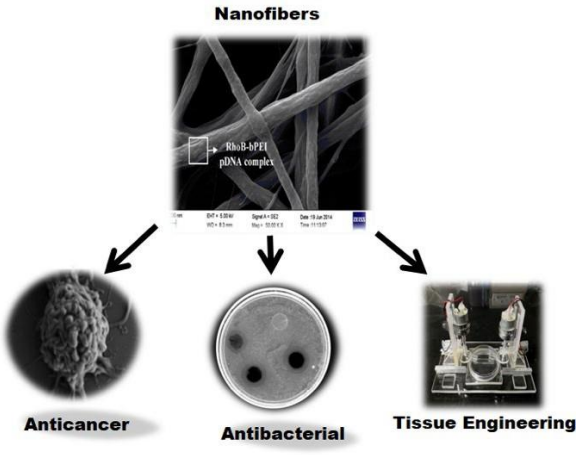
**Abstract:** Nanofibers have gained profound application in tissue engineering, wound healing and anticancer therapy. In the recent past, anticancer drug-loaded nanofibers have been sought extensively aspost-operative implants to prevent cancer recurrence and metastasis. In this quest, although numerous nanofiber-based drug delivery systems have been realized, they unfortunately remain largely ineffective due to certain disadvantages. One such drawback is their incompetence to attain a controlled and sustained drug release profile which could also be effectively tuned to meet personalised medications of diverse patients. Thus, to overcome these drawbacks, we have developed differentially cross-linkable polymeric nanofibers to deliver various therapeutic agents for anticancer and wound dressing applications. Apart from this, we have also developed novel nanofibrous scaffolds to overcome the drawback associated with the existing scaffolds for tissue engineering applications.




Nanofibers for biomedical applications

**Speaker:** Gopinath Packirisamy

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**Position:** Professor, Head- Centre for Nanotechnology

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Dr. Gopinath is a Professor in the Department of Biosciences and Bioengineering at Indian Institute of Technology (IIT) Roorkee, India. Currently, he is the Head of the Centre for Nanotechnology, IIT Roorkee. He earned his Ph.D. in Biotechnology from the Indian Institute of Technology Guwahati, India. He did his postdoctoral research at the University of Rochester Medical Center, New York, USA. His research group in the nanobiotechnology laboratory at IIT Roorkee is working on developing various nanomaterials for Biomedical applications. At present, he has more than 140 research publications in the area of nanobiotechnology in high-impact factor journals. He has filed 19 patents and done one technology transfer. He has also published eight books and 15 book chapters. His research work has been well cited with total citations of more than 6245 (h index 44; i10 index 113) till date. He is a Fellow of Royal Society of Chemistry (FRSC), United Kingdom, and Fellow of Royal Society of Biology (FRSB), United Kingdom. Further, he has received several prestigious awards for his contribution to "Biomedical research". He is the Co-founder and Director of the start-up company "Super Good Nano Pvt. Ltd."

# Single-molecule visualization of $Ca^{2+}$/calmodulin-dependent protein kinase II by HS-AFM

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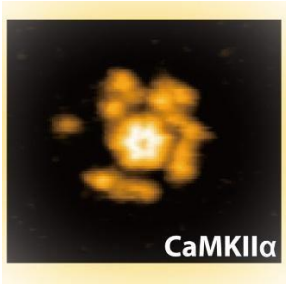
**Abstract:** The field of structural biology has significantly contributed to our understanding of how proteins work by providing detailed structures. However, these structures have been confined to static information. High-speed atomic force microscopy (HS-AFM) allows us to directly visualize individual proteins in action at sub-nanometer resolution under nearly physiological conditions. Ca2+/calmodulin- dependent protein kinase II (CaMKII) is essential for decoding calcium (Ca2+) signaling in dendritic spines, crucial to the synaptic plasticity underlying learning and memory. The direct visualization of conformational dynamics of CaMKII remains unexplored, and the mechanism by which CaMKII integrates Ca2+ signals remain elusive. In this study, we employed HS-AFM to visualize the activity- dependent structural dynamics of rat/hydra/C. elegans CaMKII. HS-AFM videos of CaMKIIα and short-linker CaMKIIα showed the circumferential subdiffusive motions of kinase domains, derived from a linker length. CaMKIIα inhibitors restricted their motions, indicating the importance of CaMKIIα activation. Furthermore, our finding revealed that the dynamic behavior is dependent on CaM binding and subsequent pT286 phosphorylation. Interestingly, only rat CaMKIIα with pT286/pT305/pT306 exhibited kinase domain oligomerization [S. Tsujioka et al. Sci. Adv. 2023]. We will discuss the detail of the conformational changes and the tolerance of phosphatase activity across different CaMKII species.




High-speed atomic force microscopy image of $Ca^{2+}$/calmodulin-dependent protein kinase II. This image was taken at 3.3 frames/second.

**Speaker:** Mikihiro Shibata

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**Position:** Professor

**Affiliation:** Nano Life Science Institute (WPI-NanoLSI), Kanazawa University

**Short biography:**

Dr. Shibata completed his Ph.D. at Nagoya Institute of Technology in 2007. After that, he worked as a post-doctoral fellow at Kanazawa University from 2008 to 2011, and then at Duke University and Max Planck Florida Institute for Neuroscience in the U.S. from 2011 to 2015. He came back to Japan in 2016 and became an Associate Professor at Kanazawa University and Professor there from 2021.

# Advancements in Highly Sensitive Detection: From Nanomaterial Labels to Cost-Effective Platforms for Real-World Applications

Werasak Surareungchai[1,2,3]

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**Abstract:** Over the past two decades, our research group has focused on achieving highly sensitive detection methods for disease diagnosis, foodborne bacteria identification, and bio-threat agent detection.We have successfully employed techniques such as DNA hybridization and antibody-antigen interaction to achieve high specificity in our detections. Our work has involved the development of various nanomaterial-based labeling platforms, including metal nanoparticles, magnetic particles, and carbon nanostructures, which offer enhanced reporting signals per binding event. Through our efforts, we have significantly lowered the limit of detection from femtomolar (fM) to attomolar (aM) for DNA hybridization and antibody-antigen binding. Additionally, we have explored the potential for high- throughput simultaneous assays using inorganic quantum dots.

However, the complexity of the developed assays has posed challenges in their application to real-world settings. To overcome this limitation, recent technological advancements have provided exciting opportunities in the field of sensing and diagnostics. Techniques such as wax printing, 3D printing, screen and/or spot printing, and roll-to-roll printing offer cost-effective platforms for tailored detection solutions.These advancements, combined with digital solutions, allow for the creation of versatile detection platforms ranging from paper-based assays to wearable monitoring devices. By leveraging smartphones as optical/spectrometric or electrochemical tools and utilizing mobile apps for data monitoring, we can bridge the gap between highly sensitive detection and practical applications. This presentation will explorethese advancements and their implications for achieving sensitive and accessible detection solutions in real-world scenarios.

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(3) Analytical Sciences and National Doping Test Institute
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Short Biography: Werasak Surareungchai is a faculty of the school of Bioresources and Technology and chairs the Nanoscience & Nanotechnology graduate program, Faculty of Science at King Mongkut's University of Technology Thonburi, and the Analytical Science and National Doping Test Institute at Mahidol University. He received PhD in Biotechnology (Biosensors and Electroanalysis) from Cranfield University, UK. He has published 110 research articles (SCI-WOS listed, h index 27); 12 book chapters and a number of proceedings. Fourteen patents have been granted and pended in Thailand, USA, and China, and he engineered three sensors & device products which are available in the market. He is the founder of spinoff companies (1) Quasense (2011) which is commercializing custom-made thick-film based electrodes and electrochemical devices; and (2) SpaceZab (2017) the space related products and services company in Thailand. He received the Thailand Outstanding Technologist award in 2016, outstanding research awards from Thailand Research Fund (TRF) in 2013 and Agriculture Research and Development Agency (ARDA) in 2015. Recently, the Sensor Technology lab is honored Science and Technology award from the Thailand Toray Science Foundation (2022). His research interests are biosensors, electroanalytical chemistry, nanobiotechnology and biodigital/digital bio.

# Multi-functional composite nanomaterials for theranostics of diseases

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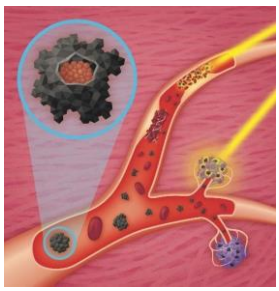
**Abstract:** The need for efficient and biocompatible treatment methods that can simultaneously deliver imaging and therapeutic agents for combined diagnosis and therapy have resulted in the development of theranostic nanoparticles in recent times. Nanotheranostics represent one of the last frontiers in precisionmedicine and provide real-time information about drug biodistribution, release, and targeted treatment invivo.

We have developed various theranostic composite nanomaterials based on metal and metal oxide such asiron oxide, cerium oxide, gold, and silver for diagnosis and treatment of diseases such as cancer, thrombosis, atherosclerosis and inflammatory diseases. Iron oxide offers magnetic resonance imaging (MRI) capability. Cerium oxide provides antioxidant, anti-inflammatory and anti-cancer effects. The incorporation of either gold or silver onto the nanoparticles not only provides photoacoustic imaging capability but also allows photothermal therapy. The developed hybrid nanomaterials were labelled with fluorescence molecules to enable optical imaging, and also tagged with targeting ligands (e.g. single chainantibodies, peptide and folic acid) for site-specific delivery of the materials.

The hybrid iron oxide/cerium oxide nanoparticles[1,2,3,4] showed excellent theranostic properties in mouse models of liver inflammation, atherosclerosis, and subcutaneous cancer. MRI was successfully employedto monitor the delivery of the materials and detect the tumor. The particles could reverse liver inflammation, treat atherosclerosis and suppress the growth of tumor while did not show any adverse effects systemically. Two other hybrid nanomaterials, gold/iron oxide[5] and silver/iron oxide[6] particles exhibited multimodal imaging capability where both MRI and photoacoustic imaging could be used to image the materials and thus allowed the detection of thrombosis and tumor in mouse models. Triggered by 808nm laser light, the nanoparticles could induce excellent thrombolysis effect and restored blood flowin the clotted artery. The laser was also employed successfully to activate photothermal apoptosis of cancercells, resulting in the elimination of tumor. While exhibiting excellent clot lysis, and anti-tumor capabilities, these materials did not show any systemic adverse effects.



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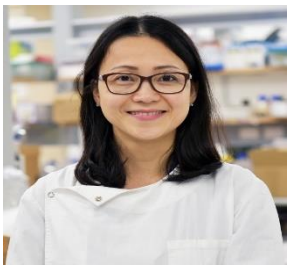

**Short biography:**

Hang Ta is an Associate Professor (Material Science) at School of Environment and Science, and Queensland Micro- and Nanotechnology Centre, Griffith University, Australia. She is a Heart Foundation Future Leader Fellow and currently leads a group of 12 students and postdocs working on (1) bio/nanomaterials for diagnosis and treatment of life-threatening diseases; (2) organ-on-the-chip, and (3) cell delivery and therapy. She has a unique skill set combining chemistry and biology skills. She got a PhD from University of Melbourne in 2009 and then worked at Baker Heart and Diabetes Institute and University of Queensland before moving to Griffith University in 2020. She has secured several competitive grants from national funding agencies for both discovery and infrastructure projects.

# Epigenetic regulation of gene expression

Yusuke Miyanari[1]

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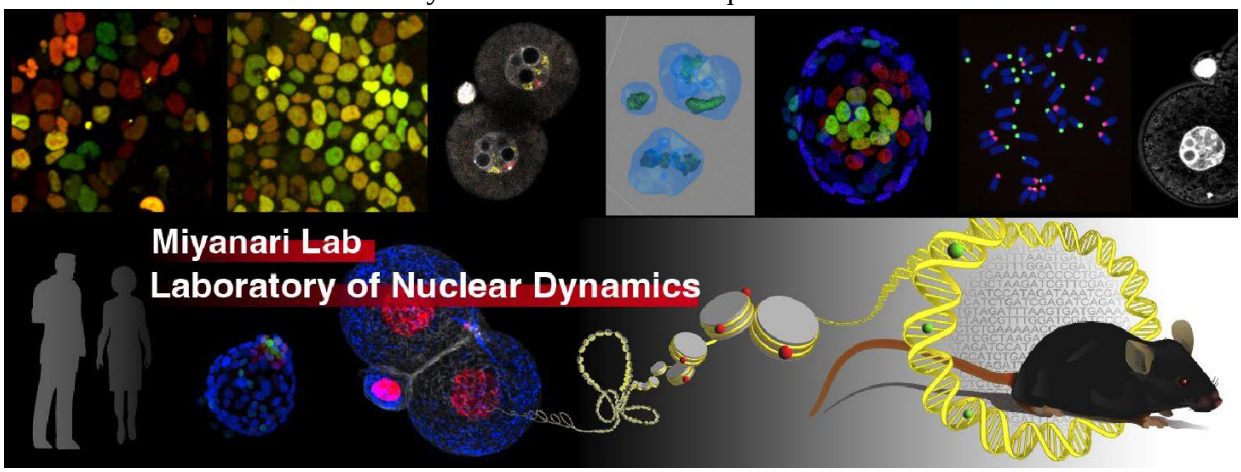
**Abstract:** Chromatin is organized in a non-random fashion within 3D nuclear space. During developmental processes, the nuclear architecture is dramatically reconstructed, resulting in the establishment of cell-type specific nuclear organization. Defects in the structural components of the nucleus are responsible for developmental aberrations and several human diseases. Remodelling of the nuclear architecture and epigenetic information leads to spatial arrangement of genes, which could affectgenome functions including gene expression. We aim to reveal the role of chromatin dynamics in cell lineage-allocation by deciphering the molecular mechanisms underlying the remodelling of nuclear organization and their effects on developmental gene expression, using mouse early embryos andembryonic stem (ES) cells as model systems. I will present our recent studies to show you how we tackleour questions.

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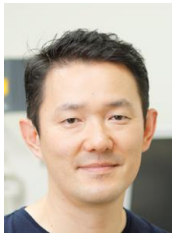
**Position:** Associate professor

**Affiliation: Kanazawa University, NanoLSI**



Biograph

| | |
|---|---|
| 2006-2009 | Postdoc, National Institute of Genetics (NIG), JAPAN (Hiro Sasaki Lab) |
| 2009-2014 | Postdoc, IGBMC, Strasbourg, FRANCE (Maria-Eleana TP Lab) |
| 2014-2020 | Associate Professor (PI), National Institute of Basic Biology (NIBB), JAPAN |
| 2020-present | Associate Professor (PI), NanoLSI, Kanazawa U. |

# Engineered Nanosystem for White Light Activated Antibacterial Photodynamic Therapy

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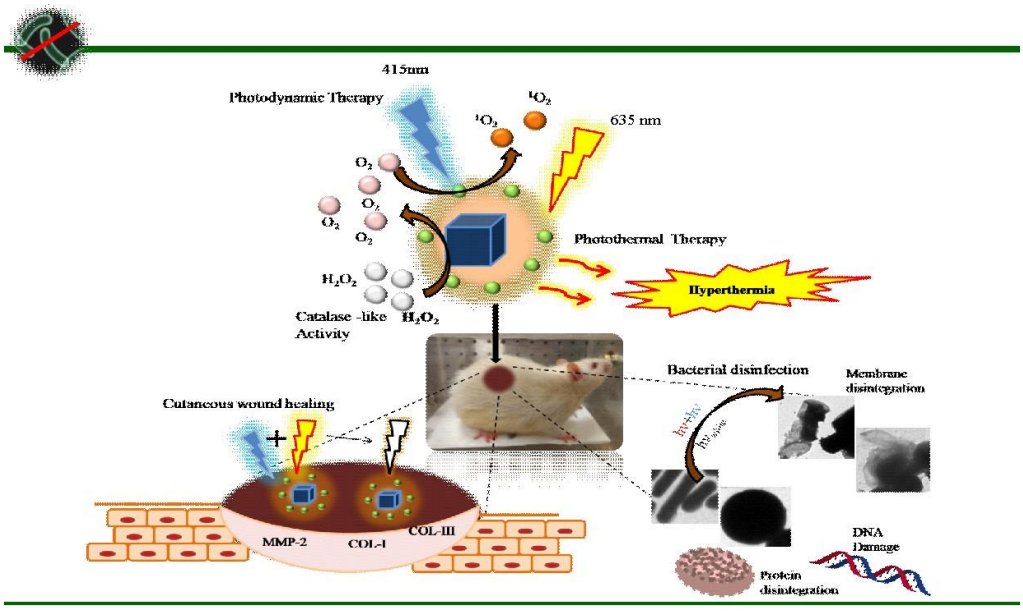
**Abstract:** Healthcare-associated infections (HAIs) spurred on by different MDR (multi-drug resistant) bacterial strains, which are primarily the main reason for concern in the post-COVID time. The best facilities for patients have been made possible by lifesaving medical advancements, but they are frequentlyaccompanied by unanticipated healthcare-associated infections that originate during surgical or medicinalprocedures. The paucity of new, effective broad-spectrum antibiotics or immunosuppressive drugsnecessitates the use of an effective and secure approach, such as photodynamic treatment (PDT). Using white light photoactivation, we present here a newly engineered nano-system based on Silver Prussian blue - Crystal violet (SPB-CV) for increased PDT to kill the microbes from any surface. White light irradiation significantly outperformed conventional antibiotics in the reduction of bacterial viability belowthe detection limit within 4 hours. White light activatable SPB-CV represents nonexistent antibacterial mode of action in nature to which resistance development is unlikely. The effectiveness of the material's antibacterial properties against drug-resistant Gram positive pathogens was investigated both with and without light activation using efficient photosensitized inactivation.



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**Short Biography :**

Dr. Hemant K. Gautam obtained his Masters and Ph.D. degree in microbiology from the (I.A.R.I), New Delhi, India . He did post doctorate from France and Israel. He is currently working as a Chief Scientist and Professor at Institute of Genomics and Integrative Biology, New-Delhi. He is associated with a number of Universities and members of various scientific and academic organizations. He is a recipient of SARC award, Bharat Excellence award, Biotechnology award, Israel Govt. Fellowship, UNESCO fellow & Intl. Project Reviewer RBUCE-UP, UniverSud, Paris, He has published more than 100 research papers, two books and over 500 new sequences have been submitted to NCBI database. He has visited several countries, including France, Israel, Australia, Bulgaria, China, Thailand, Germany, USA, Singapore, Vietnam, Malaysia and Ukraine. He has a distinguish background in the field of microbial biotechnology, microbiome, nanotechnology, biosensors and microbial genomics. Currently he is working in the area of, antimicrobial resistance and photo-dynamic therapy for skin & hospital acquired pathogens. .

# Signal transduction in unicellular and multicellular stages of *Dictyostelium*

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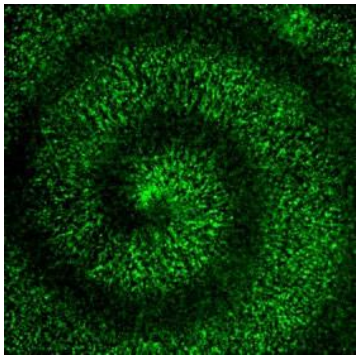
**Abstract:** Collective cell migration is ubiquitous in multicellular organisms and contributes to many biological phenomena, including morphogenesis, wound healing, and cancer invasion. The collective migration is organized by integrated physical and chemical guidance cues between cells. The social amoeba *Dictyostelium discoideum* is a model organism for the study of collective cell migration because of its morphogenesis and simple cell-cell interactions mediated by cAMP signaling. *Dictyostelium* cells grow as unicellular organisms at the vegetative stage, but upon starvation they aggregate and transition from unicellular to multicellular organisms. We have visualized the signal at each stage of *Dictyostelium*cells. Live cell imaging of cytosolic cAMP reveals that oscillations of the cAMP signal are clearly observed during the cell aggregating stage, but the periodic signals gradually disappear during the multicellular body formation stage [1]. On the other hand, $Ca^{2+}$ and c-di-GMP signals were visualized asintracellular signals that function in the multicellular stages. [2, 3].



Collective signal transduction in *Dictyostelium cells*

**Speaker:** Yusuke V. Morimoto

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**Position:** Associate Professor

**Affiliation:** Faculty of Computer Science and Systems Engineering, Kyushu Institute of Technology

**Education:**

Ph.D., Osaka University, Japan, 2011

Employment:

2012–2017, Researcher, QBiC, RIKEN

2017–2020, Assistant Professor, Faculty of Computer Science and Systems Engineering, Kyushu Institute of Technology

2020– present, Associate Professor, Faculty of Computer Science and Systems Engineering, Kyushu Institute of Technology

**Research Interests:**

Biophysics, Molecular motors, Signal transduction, Intracellular pH, Bacterial flagellum, Fluorescence microscopy, Cell migration

# Concurrent session:
# Nano Biotechnology

# Invited Speakers

# Advances in nanoformulations of natural products

Tran Quang Huy[1]

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**Abstract:** Cancer, antibiotic resistance and metabolic syndrome are major public health problems worldwide. While the development of specific anti-cancer drugs is still challenging, multidrug resistanceor metabolic disorders are also big problems for scientists. It is very necessary to find new approaches tosolve the problem, such as a combination of advanced technology and traditional methods. Recently, natural products have been recommended as natural antibiotics, and the leading choice to fight cancer- causing agents. Moreover, more than half of the chemotherapeutic drugs are derived from natural productsor their semi-synthetic derivatives which are currently used for cancer treatment. Natural products are alsorecommended as supplements or as an alternative to traditional chemotherapy avoiding side effects. Despite great benefits for human health, the effectiveness of natural products is still undermined due to their poor solubility in water, low absorption, low bioavailability, and short circulating time under physiological conditions. After use, natural compounds have to overcome chemical and physical barriersin the human body leading to a change in their natural structure and greatly affecting their bioactivity. Nanoformulations of natural compounds are expected to help increase solubility, and bioavailability, prolong circulating time in the body, minimize side effects and improve their effectiveness. It has shownpromising efficacy in treating some diseases and improving human health. This talk focuses on the most recent advances in nanoformulations of natural products for various purposes. In addition, the most recent results of our research group on advanced nanoformulations of natural products such as berberine, emodinand cordyceps powder, and their bioactivity are also discussed.

***Keywords:*** nanoformulations, cancer treatment; berberine; emodin; cordyceps powder

**References**


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**Position:** Vice Director

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**Short biography:** Dr Huy is an Assoc. Prof. of Biophysics, group leader of the nBIORD Lab. at Phenikaa University, and a former member of the Global Young Academy (GYA, 2017 - 2022). He has published more than 100 peer-reviewed journal papers (over 3,700 citations, h-index: 31 from Google Scholar). His research activities focus on nanomedicine including, nanoformulations of drugs and natural compounds, nanomaterials for drug delivery, and biosensors.

# Deciphering the actin structure-dependent preferential cooperative binding of cofilin

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Actin filaments play crucial roles in cellular processes by interacting with numerous actin binding proteins[1–3]. In our earlier study[1], we observed that the shortened helical pitch in cofilactin, where cofilin cluster is bound to actin, affected the neighboring bare zone to shorten a half helical pitch (HHP) on the pointed-end (PE) side of the cluster, while the pitch on the barbed-end (BE) side remained similar to the control. The unidirectional growth of cofilin clusters toward the PE of the filament indicated that cofilin favors actin structures with a shorter HHP. However, the exact mechanism underlying the cooperative binding of cofilin to actin filaments based on their favorable actin structure has remained unclear. To delve into this mechanism, we conducted a principal component analysis on actin structures derived from 46 PDB structures. This analysis allowed us to classify the structural differences in actin associated with different nucleotides and actin binding proteins. In particular, we found a notable contrast in the structure of ADP-actin between F-actin and cofilactin, providing a structural basis for distinguishing the impact of ADP on the preferential binding of cofilin. Furthermore, through the use of high-speed atomic force microscopy, we made a novel discovery: the shortened bare HHP on the PE side of the cluster comprised fewer actin protomers compared to the normal HHP. The mean axial distance between two adjacent actin protomers along the same long-pitch strand, referred to as MAD, in the shortened bare HHP exhibited elongation and thermal fluctuation in a larger range (5.0 – 6.3 nm) than the MAD in the normal HHP (4.3 – 5.6 nm). The impediment of cooperative structural changes in helical twisting, achieved through physical perturbation, had a more pronounced hindrance on cofilin binding and the expansion of larger clusters than the impact of inorganic phosphate. Collectively, we hypothesize that the increased fluctuation in MAD in shortened HHPs assumes a pivotal role in facilitating the preferential cooperative binding of cofilin to actin protomers.

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3. Hayakawa, Y. *et al.* Actin binding domain of Rng2 sparsely bound on F-actin strongly inhibits actin movement on myosin II. *Life Sci. Alliance* **6**, e202201469 (2022).

**Speaker:** Kien Xuan Ngo
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**Position:** Assistant Professor
**Affiliation:** WPI NanoLSI, Kanazawa University

**Short Biography**

Dr. Ngô Xuân Kiên is currently affiliated with the World Premier International Research Center for Nano Life Science Institute (WPI-NanoLSI) at Kanazawa University in Japan. He obtained his Ph.D. in Chemical Engineering from Osaka University, also in Japan. Dr. Kiên's research interests encompass a wide range of areas, including ABC transporters and multidrug resistance, actin, cofilin, myosin, microtubules, mycotoxins, lipopeptides, and more. With his expertise in biochemistry and advanced microscopy techniques, such as high-speed atomic force microscopy (HS-AFM), scanning transmission electron microscopy (STEM), and STED confocal microscopy, Dr. Kiên investigates the dynamic structures and biochemical functions of various biomolecules, including proteins, DNA, and lipids. Additionally, he is actively involved in the development of imaging techniques for biological samples, the manufacturing of small cantilevers, the design of image data analysis and processing methods, as well as computational modeling. In recognition of his significant contributions to the field of dynamic structures and physiological functions of actin protein fibers in cellular activities, Dr. Kiên has been honored with the F1000Prime award. This award highlights his numerous research achievements in this area. He is also a principal investigator who is managing several research projects in biophysical field.

# Structural dynamics of intrinsically disordered proteins and its assembly process

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**Abstract:** Intrinsically disordered proteins (IDPs) do not have a specific secondary structure and can assume a variety of dynamic structural conformations. By using the property, IDPs are involved in diverse biological phenomena (Fig. 1) that cannot be enable by conventional proteins with a fixed secondary or tertiary structure. However, there is limitation to study the structural dynamics of IDPs using conventional techniques such as x-ray crystallography. We are using high-speed AFM (HS-AFM) to visualize the structural dynamics of IDPs and try to understand the biological phenomena in which they are involved. In this presentation, I talk about the results of HS-AFM observations of the structural dynamics of monomers and oligomers containing the intrinsically disordered region (IDR) of yeast prionprotein Sup35NM, and the role of the IDR in the formation of Sup35NM aggregates. In addition, I talk about structuring of IDR in E6AP ubiquitin ligase induced by interactions with E6 protein derived from oncogenic human papilloma virus (HPV 16/18), a major cause of cervical cancer.

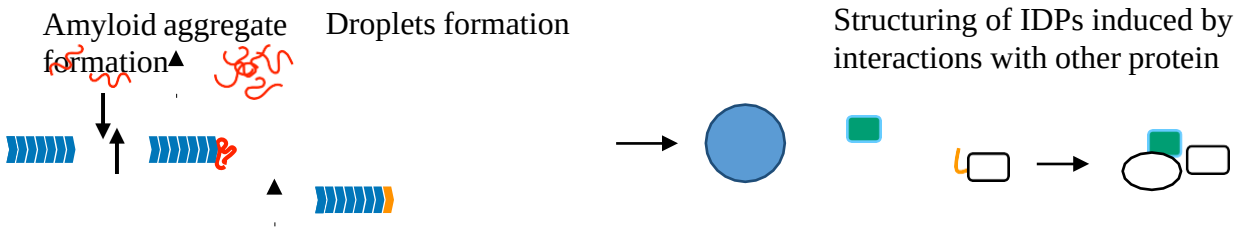


Fig. 1 Biological phenomena involving IDPs

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**Position:** Associate Professor

**Affiliation:** Nano Life Science Institute (NanoLSI), Kanazawa University

**Biography:**

Hiroki Konno has completed his PhD from Tokyo Institute of Technology (Tokyo Tech) in 2002 and postdoctoral studies from Tokyo Tech. In 2006, he joined chemical resources laboratory, Tokyo Tech, as an assistant professor. In the above period, he has studied regulation mechanism of rotary motor, ATP synthase, with biochemical and biophysical methods. He has been with the imaging research division of Bio-AFM Frontier Research Centre since November 2011, and with the nanometrology division of Nano Life Science Institute (NanoLSI) since October 2017 in Kanazawa University, where he is currently an associate professor. His current research interests include observing structural dynamics of various protein molecule with HS-AFM.

# Targeting α-synuclein inclusions by GQDs in an MSA model

Małgorzata Kujawska[1], Yasuo Miki[2], Kunikazu Tanji[2], Sheetal Kaushik Bhardwaj[3,4], Ajeet Kaushik[5], Tuba Oz[1], KoichiWakabayashi[2]

[1]Department of Toxicology, Poznan University of Medical Sciences, Poznań, Poland;

[2]Department of Neuropathology, Hirosaki University Graduate School of Medicine, Hirosaki, Japan;

[3]Van't Hoff Institute for Molecular Sciences, University of Amsterdam, Amsterdam, The Netherlands;

[4]Amsterdam Scientific Instruments, Amsterdam, The Netherlands;

[5]Department of Environmental Engineering, Florida Polytechnic University, Lakeland, FL, United States

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**Abstract:** Proteins in their normal form of soluble monomers exert physiological functions, which are lost after converting them into insoluble amyloids. Synucleinopathies are neurodegenerative diseases characterized by the abnormal accumulation of aggregated α-synuclein (α-syn) in neurons (Parkinson'sdisease) or glial cells (Multiple Systems Atrophy, MSA). Targeting the surfaces of α-syn inclusions is suggested to hold therapeutic potential, and nanotechnology is an emerging approach for treating this pathology. This is even more important as the current therapeutic approach is symptomatic and palliative.

The project aimed to study the potential of graphene quantum dots (GQDs) to target synucleinopathy in amouse model of MSA. In the first stage, we assessed the ability of GQDs to interact directly with maturefibrils in vitro. Subsequently, we studied the impact of intranasal treatment with GQDs in a mice MSA model.

In in vitro stage, we estimated the level of α-syn fibrillization of preformed fibrils of α-syn incubated with GQDs based on fluorometric (thioflavin T) and spectrophotometric (turbidity assay) measurements and assessed the cytotoxicity of tested GQDs in a cell line. In an in vivo study, MSA mice were treated intranasally thrice weekly for four weeks with GQDs. To assess the effectiveness of the treatment, we performed a behavioural test. Moreover, we performed biochemical and immunohistochemical analyses of the α-syn expression in the harvested brains in different brain areas.

The obtained results indicate the ability of tested GQDs to interact with α-syn inclusions. However, as there is a lack of reliable tools and assays enabling the reproducible detection and quantification of pathogenic forms of α-syn, extended research also about downstream effects is required.

The project was supported by Narodowe Centrum Nauki, No. 2021/42/E/NZ7/00246 and the Matsumae International Foundation Fellowship 2020 Program.

***Keywords**: graphene, α-synuclein, neurodegeneration, Parkinson's disease, MSA,*

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# Application of Silver nanoparticles (AgNPs) for Management of White Grubs (*Holotrichia spp*.) in Sugarcane crop

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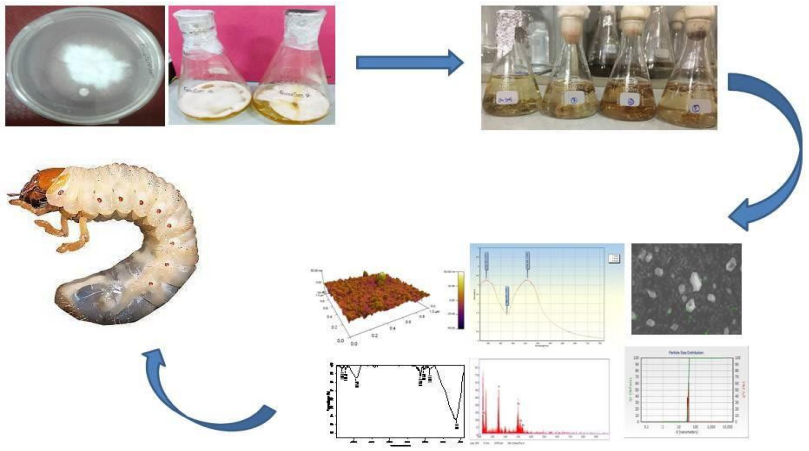
**Abstract:** Silver nanoparticles (AgNPs) were prepared using *Fusarium pallidoroseum* biomass. Their effectiveness was examined against different larval stages of white grubs (Holotrichia sp), a major sugarcane pest in western Uttar Pradesh (India). The white grub infestation level was surveyed in the agricultural fields of Western UP and collected grubs were preserved in the laboratory. The AgNPs weresubjected to various characterization techniques such as UV-Visible Spectroscopy, Field EmissionScanning Electron Microscopy (FESEM), Energy Dispersive X-Ray (EDX), Dynamic Light Scattering (DLS), Fourier-transform infrared spectroscopy (FTIR), Atomic Force Microscopy (AFM), and inductively coupled plasma mass spectroscopy (ICPMS). The UV-Vis spectroscopy revealed a peak rangeof 410 to 430 nm, corresponding to AgNPs. The FESEM results confirmed the successful synthesis of nanosized particles. EDX analysis depicted the elemental composition of nanoparticles. DLS results verified the synthesis of AgNPs with an average size of 83.28 nm. FTIR analysis provided insights into the chemical interactions of AgNPs. AFM imaging captured the three-dimensional structure of AgNPs. The results of white grub sampling suggested beyond threshold levels of white grub infestation in many areas. However, Bijnor showed only moderate soil infestation levels. Total six different beetle species were collected, all belonging to the family *Scarabaeidae* and order *Coleoptera*. The most abundant speciesfound in the survey were *H. serrata* and *H. consanguinea.* In vitro application of the AgNPs against thirdinstar white grub larvae enabled the determination of the lethal dosage (LD50) through Probit analysis, which was further validated and found to be statistically significant at the 0.05 level using the chi-squaretest. The LD50 of AgNPs against first and third instar larvae were calculated to be 9.64 ppm ($\chi^2$ = 1.097) and 117.46 ppm ($\chi^2$ = 0.315) respectively. The ED50 for AgNPs was calculated as 58.73 ppm. The white grub-stressed tomato plants treated with nanoparticles showed overall significantly higher growth parameters as compared to those treated with the biopesticides at $P<0.05$. The biopesticide showed 0% mortality towards the third instar larvae. The nanoparticles were much effective against first instar larvae(near 100% mortality) as compared to the third instar. The nanoparticle solution was mixed with Sigma-Aldrich *Carbopol® 940* powder to make 1% carbopol concentration with the nanoparticle solutions to prepare the nano-formulations. The study concluded that the AgNPs can be used as nanopesticides for white grub management and can replace hazardous chemical pesticides and lesser effective biopesticidesin near future.

***Keywords****: Silver Nanoparticles, white grubs, pest-management, sugarcane, Nanopesticide.*



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# Oral Talks

# Bioengineering and characterization of green-synthesized silver nanoparticles with anticancer activity against human breast cancer cells

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**Abstract:** Fungal endophytes have emerged as a valuable source of bioactive compounds, harboring immense potential for a wide range of biomedical applications including their metal ion-reducingpotential. In light of this, the current study aims to synthesize silver nanoparticle mediated by endophyte *Colletotrichum gloeosporioides*, and unveiled their apoptosis inducing potential. The UV-Vis spectra revealed the presence of a sharp absorption band at 420 nm, which corresponds to the surface plasmon resonance of *C. gloeosporioides* mediated silver nanoparticles (CgAgNPs). Further, FT-IR spectravalidated the reduction of silver salt and capping of silver metal through bioactive compounds of *C. gloeosporioides*. The XRD and AFM analyses revealed that the CgAgNPs exhibited a crystalline structure and possessed a uniform spherical morphology, whereas the microscopic techniques TEM, and FESEM indicated the size of CgAgNPs ranging from 15-20 nm. Moreover, the *in vitro* study demonstrated that CgAgNPs exhibits significant cytotoxicity to MDA-MB-231 and MCF-7 cells with $IC_{50}$ values of 18.17±0.707 and 38.85±2.64 µg/mL, respectively. CgAgNPs also altered the metabolic activity, as evidenced by a reduction in glucose uptake and an elevation in the release of lactatedehydrogenase enzyme into the culture supernatant. Additionally, CgAgNPs exhibit the potential to hinder the wound healing ability of breast cancer cells. The CgAgNPs mediated alteration in nuclear morphology and loss of cellular integrity of MDA-MB-231 and MCF-7 cells indicate onset of apoptosis.CgAgNPs decreased the expression of the anti-apoptotic gene *BCL-2*. Conversely, CgAgNPs upregulated the expression of genes associated with cell-cycle arrest (*P21*), tumor suppression (*P53*), and apoptosis (*BAX*). Conclusively, our findings revealed the ability of CgAgNPs to induce apoptosis in breast cancer cells, which will open new avenues towards breast cancer therapeutics and management in the coming future.

***Keywords****: Myconanotechnology, Fungal endophyte, Colletotrichum gloeosporioides, Breast cancer, Apoptosis.*

# Elucidating the process of pore formation by alpha-hemolysin on lipid membranesusing High-speed Atomic Force Microscopy

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**Abstract:** *Staphylococcus aureus*, a harmful pathogen, possesses various virulence factors, including alpha, beta, and gamma toxins. Among these, the alpha toxin, also known as alpha-hemolysin (Hla), standsout for its capability to form pores in specific lipid membranes. The static structure of the Hla pore, as revealed by x-ray crystallography, consists of seven monomers arranged in a heptameric configuration. The current prevailing hypothesis outlines the assembly mechanism for the formation of the Hla pore in lipid membranes, involving four main processes. Firstly, Hla is secreted as a water-soluble monomeric protein that binds to target lipid membranes containing cholesterol, phosphatidylcholine, and sphingomyelin. Secondly, upon binding to the membrane, it undergoes oligomerization on the lipid surface. Thirdly, a heptamer pre-pore structure is formed on the lipid membrane. Finally, this pre-pore undergoes a transition into a membrane-inserted heptamer pore, thereby endowing Hla with its characteristic as a bacterial pore-forming toxin. Despite the current understanding of these complex processes, the kinetics of dynamic conformational transition within each step have not been demonstratedbefore, making it challenging to fully comprehend the precise mechanism of Hla pore formation.

The primary objective of this research is to elucidate the process of pore formation by Hla on lipid membranes and explore potential strategies to prevent this process. To achieve this goal, we conducted aseries of biochemical experiments and utilized High-speed Atomic Force Microscopy (HS-AFM). After successfully constructing and purifying wild-type Hla ($Hla_{WT}$), we created liposomes with specific lipid compositions, including phosphatidylcholine and cholesterol, to facilitate the investigation of lipiddependence of Hla's pore-forming activity in lipid membranes.

Using HS-AFM, we were able to observe in real-time the binding of monomeric Hla to the lipid membrane, as well as the transition from pre-pore to pore formation of $Hla_{WT}$ on the targeted lipid

membrane. Interestingly, our study revealed that the $Hla_{WT}$ pore is composed of six monomers arranged in a hexamer configuration. This finding is in contrast to the current PDB structures, which were resolved using x-ray crystallography. We believe that this discrepancy in results may arise from the distinct environments in which the Hla pore was formed. Our study using lipid membranes versus the artificial conditions employed in x-ray crystallography. Addressing this fundamental gap in knowledge is crucial to gain deeper insights into the molecular events driving the Hla pore formation process.

***Keywords****: HS-AFM, Staphylococcus aureus, alpha-toxin, Hla, pore, pre-pore*

# Nail Polish - A Simple And Low-cost Procedure For Fabrication of Paper-BasedMicrofluidic Device

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**Abstract:** A simple and low-cost procedure for the fabrication of paper-based microfluidic device was proposed using nail polish. Hydrophobic barriers were created by painting nail polish onto paper surface.The main components of nail polish are solvent, film formers, resin, plasticizers. When the solvent evaporates after drying, the polymer film remains and makes the painted surface hydrophobic. In this paper, we employed nail polish as a simple strategy for fabricating paper-based device. The device was then used to screen the presence of infectious bacteria. The proposed method offers an interesting advancein microfluidic fabrication since it combines the satisfaction of analysis performance with simplicity andwidely available low-cost materials.

***Keywords****: Bacteria, Microfluidics, Nail Polish, Paper-based Device, Point-of-care Testing*

# Combination of nanopipette-based non-thermal atmospheric pressure plasma and scanning ion conductance microscopy for investigating plasma-induced modification on cell membrane

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**Abstract:** Transfection is a useful supporting method for advancing our understanding of cellular processes, disease mechanisms and finding potential therapies. Recently, non-thermal atmospheric pressure plasma (NTAPP) has gained attention in life science as a promising technique for high transfection efficiency. Yet, the underlying transfecting principle of NTAPP remains unclear, suggesting an investigation into its mechanism to achieve precise transfection using plasma. To understand how NTAPP enhances the permeability of cell membranes, we utilized scanning electron microscopy (SEM), scanning ion conductance microscopy (SICM), and atomic force microscopy (AFM) to visualize NTAPP's effects on cell membranes. In previous trials, we exposed the cell membrane to NTAPP for different exposure time (10 s, 13 s, and 50 s) and stopped the cell degradation using glutaraldehyde before conducting visualizations using microscopies. In our observations, pore-like structures, with diameters ranging from several tens to hundreds of nanometers, were found on the fixed cell membranes. These results suggested that the NTAPP generated pore structures, thereby promoting transfection. However, it is challenging to distinguish between pores formed directly and indirectly by NTAPP, and those arising from cell functions such as exocytosis or endocytosis, due to the lack of dynamic information under the application of NTAPP. In this study, to address this issue, we fabricated a NTAPP probe that can stimulate individual cells locally and attempted to combine it with SICM to capture real-time changes in the cell membrane due to NTAPP. The results of our efforts will be presented.

***Keywords**: Scanning ion conductance microscopy, non-thermal atmospheric pressure plasma*

# Drug delivery systems based on electrospun PLA nanofibers with core/sheath andblended structures

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**Abstract:** Nanotechnology has developed amazingly in recent years and brought many achievements in life science. Among various types of nanomaterials, polymeric nanofibers are considered as potential drugdelivery systems which are able to control the rate and time of drug release to achieve the effective therapeutic effect. The nanofibers can be fabricated by electrospinning technique, using a strong electricalfield to produce fibers with a diameter from micro- to nanometers. They have unique characteristics, suchas high surface area-to-volume ratio, interconnected porosity, good mechanical performance, and flexibility in composition and structure modifications. The nanofibers enable high drug loading and designdifferent drug release profiles, such as rapid, prolonged, biphasic, pulsed, and stimulus-activated drug release. In this study, poly(lactic acid) (PLA) based nanofibers with core/shell and blended structure usedfor release drugs, namely salicylic acid (SA) and berberine (BBR), were reported. The core/sheath structure of PLA nanofibers showed a sustained release of SA over 120 hours at a lower ratio of core composition. Meanwhile, BBR released from blend structure of PLA nanofibers prolonged in 64 hours. These nanofibers may find promising applications in the development of drug delivery systems with long-lasting activity applied for oral, topical, transmucosal, and transdermal routes.

***Keywords**: Poly(lactic acid), nanofibers, electrospinning, drug release system, controlled release*

# Direct observation of the interactions of cyclase-associated protein with actin filaments by high-speed atomic force microscopy

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**Abstract:** Cyclase-associated proteins (CAP) are a family of conserved actin-binding proteins (ABPs) that are necessary for actin-dependent cellular processes [1]. Recent florescence microscope studies show that synergy between CAP and cofilin, another ABP, promotes disassembling and remodeling of actin filaments [2,3]. However, the structural and functional information is not fully understood. In this study, we observed the interaction of *Xenopus* cyclase-associated protein 1 (XCAP1) [4] with actin or cofilin-bound actin (cofilactin) filaments by high-speed atomic force microscopy. We found that XCAP1 transiently binds to the sides and ends of bare actin filaments with the same preference of the positions. Interestingly, the binding of XCAP1 elongates the helical pitch of actin filament by ~10%. Moreover, cofilin dissociates extensively when XCAP1 was added to cofilactin filaments. This resulted in enhanced filament severing by producing patches of actin- and cofilactin clusters within the filaments. Our results explain the function of CAP1 in increasing the actin turnover rate.

***Keywords****: high-speed atomic force microscopy (HS-AFM), actin filament, actin binding protein, CAP, cofilin, severing, depolymerization.*

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# Evaluation of Electrical Conductivity,Antioxidant and antimicrobial activity of ZnOnano particles and *Catharanthus roseus* leaf extracts against organisms causing dandruff

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**Abstract:** Plants have traditionally been used as antibacterial agents and are good source of antioxidants.Therapeutic properties of herbal extracts can be attributed to its antioxidant activity. The antioxidant capacity and electrical conductivity of plant extracts are directly correlated. The literature suggests that herbal extracts and nanoparticles with good antioxidant properties have shown considerable amount of electrical conductivity. Though Plants are rich in secondary metabolites with potential antimicrobial properties, the bioactivity is limited due to multidrug resistant properties of the microorganism. One of thestrategies to improve the antimicrobial action of the plant extracts is by addition of Nanoparticles to the extracts. Nanoparticle have been used to improve the antimicrobial activity of plant extract/constituents.

The objective of the present study is to examine the antioxidant and electrical conductivity of *Catharanthus roseus* leaf extracts and ZnO nanoparticles and to determine if there is a synergistic effect when they were used in combination as antimicrobial agents against organisms causing dandruff. The antioxidant property was determined using DPPH 2,2-Diphenyl-1-picrylhydrazyl method. The 2,2- Diphenyl-1-picrylhydrazyl (DPPH) is a popular, quick, easy, and affordable approach for the measurementof antioxidant properties that includes the use of the free radicals used for assessing the potential of substances to serve as hydrogen providers or free-radical scavengers (FRS). The antimicrobial activity ofwas tested using Agar diffusion method. The present study indicated a direct correlation between the conductivity and antioxidant potential of the extracts and the nanoparticles. Further it was found that the antioxidant activity was concentration dependent and could be linked to the existence of charge carriers as shown by the dielectric experiments.

***Keywords**: Catharanthus roseus, ZnO Nanoparticles, antioxidant activity, conductivity, antimicrobial activity.*

# IN VITRO STUDY OF MICROBIAL – IRON NANOCOMPOSITE IN METALREMOVAL AND IMPACT ON PLANT GROWTH

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**Abstract:**

Industrialization and accumulation of toxic wastes in soil has an adverse effect on flora and fauna as the toxic compounds get into the soil and alter the soil physico chemical properties. Soil, the basic substrate for the plants as well as soil microflora is mostly affected because of these compounds. Toxic waste includes heavy metals having a major impact on the plant's physiological and biochemical processes affecting plant yield and eventually leading to food insecurity. Thus, there is a requirement of remediationprocess for the heavy metal removal in soils. Plants uptake the heavy metals and accumulate within theirtissues exhibiting phytotoxicity. Most abundant toxic metal which is ubiquitously distributed in soil is Lead which gets into soil through the disposal of electronic industrial effluents. During the study, the reduction in toxicity of Lead metal by the bioremediant, *Bacillus licheniformis* isolate and Biocomposite comprising *Bacillus licheniformis* and magnetite nanoparticles leading to the promotion of plant growth was studied. In one set 1000 ppm of Lead metal was incorporated into soil and chilli seeds were sown andin the second set electronic waste soil containing 1754 ppm Lead metal, tomato plant growth was monitored. It was observed that in chilli plant soils, the concentration of the metal reduced by the isolate was 53%, with magnetite nanoparticles it was 40% and with Microbial - Iron nanocomposites it was 44% which concludes that *Bacillus licheniformis* isolate can be an effective bioremediant in reducing the metalstress on the plants. In a similar way with the second set of soil where tomato plants were sown the amountof metal reduced with isolate was 28.78 %, with nanoparticles it was 41.76 % and with Microbial - Iron nanocomposites it was 23.60 % . In addition to the metal concentration reduction in the soils the shoot length of the plant was also monitored in order to determine the effect of low metal stress on plant growth.It was observed that in chilli plants without isolate (control) the shoot length was 2.5 cm, with the isolatethe shoot length was 18.6 cm, with Magnetite nanoparticles it was 16.1cm and with Microbial - Iron nanocomposites it was 16.6cm. In tomato plants with the isolate the shoot length was 4.2cm, with magnetite nanoparticles it was 3 cm and with Microbial -

Iron nanocomposites it was 4.6cm. The amountof metal reduced in both the types of soils by the isolate *Bacillus licheniformis* was able to reduce the Lead metal concentration to a greater extent compared to Magnetite nanoparticles and Microbial – Iron nanocomposites. Plant growth was found to be better in soil containing *Bacillus licheniformis* culture whencompared to soils containing only nanoparticles and Microbial - Iron nanocomposites. This confirms thatthe bacterial isolate *Bacillus licheniformis* is an effective biosorbent and bioremediant.

***Keywords***: *Heavy metals, Bioremediation, Magnetite nanoparticles, Microbial -Iron nanocomposites*

# Synthesis of Silver Nanoparticles by Exopolysaccharide producing *Levilactobacillus brevis*

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**Abstract**: Exopolysaccharides (EPS) are high molecular weight and biodegradable polymers biosynthesized by a wide range of bacteria. Lactic acid bacteria (LAB) secrete extracellular polysaccharide either associated with bacterial cell wall or liberated into the medium. LAB are considered as an important group of EPS producers as they are included under Generally Recognised as Safe (GRAS). The Green synthesis of Nanoparticles using cell free supernatant of bacterial cultures and by EPS was studied an investigated for their applications.

The current research involved the isolation of EPS producer, *Levilactobacillus.brevis* and its use in the production of nanoparticles and potential application. The *Levilactobacillus.brevis was isolated* from a ferment food. Sucrose was used as a carbon source for EPS production with an optimum temperature of 37º C, pH of 6.8 with a time duration of 24hrs. Ethanol precipitation method was employed for extraction of EPS. The extracted EPS was purified bydialysis and antibacterial activity was checked by agar spot method. The production of silver nanoparticles by using *Levilactobacillus.brevis* cell free supernatant and EPS independently at optimum conditions was studied. The production for nanoparticles was investigated by color change and UV-Vis spectrophotometer. The obtained nanoparticles were further observed forantibacterial activity by agar well diffusion method. The observations indicated that green synthesis of nanoparticles and its application have proved to be satisfactory.

***Keywords:*** *Levilactobacillu.brevis*, EPS, Silver nanoparticles, antibacterial activity.

# Developing strategies for intracellular exploration by scanning probe microscopy

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**Abstract:** Atomic force microscopy (AFM) can image biological samples, including living cells, with high resolution under physiological conditions. Nonetheless, intracellular structures or organelles are usually hidden beneath the plasma membrane from direct nanoprobe access. Atomic force microscope (AFM) can explore the ultrastructure and topography to help us understand intracellular structures insidethe cells. Using AFM nanoedoscope to explore stress fibers inside the cells, the first step is to remove thecell membrane without significant damage. By introducing ultrasonic bursts on the cells, de-roofing cellsis a typical technique for removing the membrane. *(J Cell Sci. ,118 (22): 5315–5323(2005)).* However, this technique applies a force to tear off the upper cell membrane. It may cause some structural damage while sonicating. Therefore, we need to develop a gentler method to remove the cell membrane. We haveexplored different strategies for creating transient micrometer-sized pores in the plasma membrane as temporary windows into the cell interior, using pore-forming peptides, enzymatic phospholipid digestion,or light-switchable membrane intercalator. We demonstrate that porcine phospholipase A2 (PLA2) creates pore structures in artificial phospholipid membranes within 30 min. Likewise, adding PLA2 to living cellscreates micrometer-sized transient pores in the plasma membrane, usually closing within 90 sec, as confirmed by phase-contrast light microscopy, tomographic holography, and AFM imaging. Pore formation could be induced several times by repeated application of additional PLA2, while cell viabilitywas maintained for at least 1.5 hours after PLA2 addition, and intracellular structures, such as the actin cytoskeleton, were also preserved. Enzymatic hydrolyzation of plasma membrane phospholipids may therefore be a suitable and non-destructive way to create temporary openings for intracellular nanoprobe imaging of living cells.

***Keywords**: Scanning probe microscopy, Atomic force microscope, intracellular imaging*

# High-speed atomic force microscopy reveals dynamic unfolding of the laminin coiled-coil domain

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**Abstract:** Laminins are trimeric glycoproteins with important roles in cell-matrix adhesion and tissue organization. All laminin isoforms contain an α-, β-, and γ-chain. While the N-terminal regions of each chain exist alone (laminin short arms), the C-terminal regions form a triple coiled-coil domain (laminin long arm). As a result, laminins assume a striking cross-shaped morphology. The α-chain features additional laminin G-like (LG) domains downstream of the coiled-coil region. Dynamic rearrangementof different laminin domains has been previously implicated in the regulation of laminin function, but so far such conformational changes have not been studied at single molecule level. High-speed atomic forcemicroscopy (HS-AFM) is a unique tool that allows for the simultaneous assessment of the structure and dynamics of single molecules during their functional activity at sub-second temporal, 2-3 nm lateral and
~0.1 nm vertical resolution. Using HS-AFM imaging we observe dynamic unfolding of a ~35 aminoacid stretch of the laminin α-chain, leading to temporary unraveling of the C-terminus of the laminin triple coiled-coil domain just before the α-chain LG domains. As in full-length laminin, similar coiled- coil unwinding was also observed in a recombinant E8 fragment of laminin containing only the C- terminal coiled-coil and LG domains. We furthermore identified laminin isoform-specific amino acid sequences required for α-chain unfolding. Interestingly, the C-terminus of the laminin coiled-coil domain also contains binding sites for integrin receptors and other adhesion proteins, suggesting that reversible α-chain unfolding may regulate the cell adhesion properties of some laminin isoforms. HS- AFM imaging can therefore reveal dynamic conformational changes in individual laminin molecules regulating its biological activity.

***Keywords****: Laminin, coiled-coil, domain, unfolding, HS-AFM*

# Anodic Aluminum Oxide (AAO) Template Guided Plasmonic NanoArray Fabrication and Their Application

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**Abstract:** Anodic aluminum oxide (AAO) platforms formed by the electrochemical oxidation of aluminum have been used for various applications such as sensing, storage, separation, and template synthesis of different nanostructures and patterns. In this study, the ability to control two dimensions of AAO with uniform and highly ordered nanopores *via* two-step anodization allows AAO to use as a guidedtemplate for the fabrication of different types of nanostructures. The simple ultra-sonication method was utilized as a novel fast and straightforward for the self-assembly of plasmonic nanoparticles inside AAO nanopores. We successfully developed monomeric, dimeric, and multimeric plasmon nanoarrays of Au and Ag. The inter-particle distances were fixed and kept constant to be approximately the *edge-to-edge* distance of the AAO nanopore. The plasmonic substrate with high homogeneity of the number of nanoparticle-per-pore from monomeric 1NP/pore (98%) to dimeric 2NPs/pore (95%) and multimeric 3±1NPs/pore (91%), 5±1 NPs/pore (92%), and 7±NPs/pore (86%). As-prepared plasmonic substrates were applied for SERS with high sensitivity and producibility. Regarding monomeric Au and Ag nanoarrays, the lowest detectable Rhodamine 6G (Rh6G) by as-prepared Au and Ag array was 50 nM, which was significantly lower than that of citrate-reduced Au and Ag (1µM). The enhancement factor (EF) was obtained at $2.5x10^4$ and $2.3x10^4$, respectively. We developed hybrid on-chip PCR integrated with SERS detection through dimeric Au nanoarray with a total detection time ~4 times faster than the conventional PCR method, including running time. Due to the high density of hotspots on the surface, the multimeric nanoarrays exhibited the LOD of acetamiprid detection of ~20 nM with an RDS of 6.64 %. The photocatalytic of 4-nitrobenzenthiol on plasmonic nanoarrays was studied. The photocatalytic behavior ofthe Ag array was demonstrated more effective than the Au array. The as-prepared asymmetric plasmonicplatforms also exhibited Fano-like type resonance.

***Keywords**: Anodic Aluminum Oxide (AAO), SERS, plasmonic nanoarray, hotspots, Fano-like resonance*

# Enhancement of antidandruff activity of shampoo by biosynthesized silver nanoparticles using lemon peel extract against *Malassezia furfur*

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**Abstract:** Dandruff is a scalp disorder identified by the shedding of skin cells from the scalp. Three etiological factors are responsible for dandruff - The fungi called *Malassezia*, Sebaceous secretions & individual sensitivity. The treatment options currently available for dandruff are unable to prevent the reoccurrence of dandruff and side effects cannot be neglected. Herbal extracts are proved to be better alternatives for the chemical preparations. Investigations for antifungal activity of various herbal extracts against *Malassezia furfur* was carried out. Of all theherbal extracts *Citrus lemonis* peel extract had proved to have promising antidandruff activity.

Phytochemical screening of lemon peel powder revealed the presence of carbohydrates, alkaloids, flavonoids and steroids. Nanoparticles can be designed to deliver the formulations ofdrugs in a sustained and targeted manner to avoid adverse side effects. Biological methods of synthesizing nanoparticles seem to be the best ones as they are ecofriendly, cheap and easy to synthesize. Therefore in the current study an attempt was made for the green synthesis of silver nanoparticles using *Citrus lemonis* peel extract. Silver nanoparticles have earned great attention in nanobiotechnology due to their physical, chemical & biological properties. The physicochemical properties of AgNPs were characterized based on the color change and UV- visible spectrophotometer. Dandruff can be treated with shampoos containing antifungal ingredients. Anti-dandruff shampoos were formulated with synthesized AgNPs and their organoleptic properties were studied. The formulated Nano shampoos have also been tested for antifungal activity against *Malasezzia furfur.*

***Key words:*** *Dandruff, Malassezia furfur, Nanoparticles, Citrus lemonis, AgNPs*

# Concurrent session:
# Biosensor

# Invited Speakers

# Modulatory effects of noradrenergic and serotonergic signaling pathway on neurovascular coupling

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**Abstract:** The brain requires a continuous supply of nutrients and oxygen to fuel its normal functioning. Active areas of the brain need more energy than relatively quiescent regions reflecting the ongoing metabolic needs of active neurons, a need that is met through dynamic regulation of the blood supply to different areas of the brain over time. Observed dynamic changes in astrocyte $Ca^{2+}$ are recognized as contributors to functional hyperemia, a critical response to increased neuronal activity mediated by a process known as neurovascular coupling (NVC). Although the mechanistic basis of astrocyte-vasculaturerelationships remains to be elucidated, the critical role of glutamatergic signaling in these processes has been extensively investigated. Interestingly, the impact of behavior, and the release of behavior-associatedneuromodulatory neurotransmitters, on astrocyte $Ca^{2+}$ dynamics and functional hyperemia have received less attention. The roles of norepinephrine and serotonin (5-HT) in the central nervous system are similarly understudied, despite the fact that both are potent vasoconstrictors in the peripheral system. The development of a completely awake, chronic *in vivo* two-photon imaging model has allowed investigators to examine the contributions of animal behavior to NVC at a cellular level and consequently propose a role for noradrenergic signaling in regulating astrocyte $Ca^{2+}$ signals, but a role for this signaling in functional hyperemia has not yet been established. Whether other behavior-associated neuromodulatory neurotransmitters, such as 5-HT, contribute to NVC also remains unknown. We used two-photon imagingof the barrel cortex in completely awake, behaving mice running on a passively air-supported treadmill toexamine the role of noradrenergic and serotonergic neurons in sensory-induced astrocyte $Ca^{2+}$ signals andfunctional hyperemia. We found that both noradrenergic and serotonergic neurons facilitated sensory- induced increases in astrocyte $Ca^{2+}$. Interestingly, while ablation of serotonergic neurons reduced sensory-induced functional hyperemia, ablation of noradrenergic neurons caused both attenuation and potentiationof functional hyperemia. Our study demonstrates that 5-HT is involved in modulating sensory-induced astrocyte $Ca^{2+}$ elevations and identifies differential effects of norepinephrine and 5-HT in regulating functional hyperemia, providing a first step in exploring the contributions of these two neuromodulators to NVC.

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**Short biography**:

Dr. Tran completed her undergraduate studies at the University of Alberta, Canada with specialization in physiology and developmental biology. Subsequently, she finished a Master of Biomedical Technology degree at the University of Calgary, Canada. Dr. Tran then obtained her PhD in cardiovascular and respiratory sciences under the supervision of Dr. Welsh. Her PhD thesis focused on signaling mechanisms and physiological function of electrical and second messenger communication in small resistance arteries. She joined Dr. Gordon's laboratory at the University of Calgary, Canada, as a postdoctoral fellow in pursuing research in neurovascular coupling. During her postdoctoral training, she pioneered a highly novel and exciting technique in studying the neurovascular unit: a fully awake behaving mouse in vivo two-photon imaging model. She has uncovered a unique bidirectional communication between members of the neurovascular unit. Her works have been presented at international conferences and published in a number of high impact journals including Neuron. She is currently an assistant professor at the University of Nevada Reno School of Medicine. She continues to pursuit her research interest in blood flow regulation particularly the interaction between members of the neurovascular unit in the cerebral microcirculation. Her lab is currently supported by 2 NIH grants to investigate: 1) how changes in the vasculature affect astrocyte functions in young and aging brains; 2) the integrated role of serotonin in neurovascular coupling during sensory stimulation and the mechanistic basis of the process.

# Biphasic reinforcement of nascent adhesions by vinculin

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**Abstract:** Vinculin is an integral component of integrin adhesions, where it functions as a molecular clutch coupling intracellular contraction to the extracellular matrix. Quantitating its contribution to the reinforcement of newly forming adhesions, however, requires ultrasensitive cell force assays covering short time and low force ranges. Here, we have combined atomic force microscopy-based single-cell force spectroscopy (SCFS) and optical tweezers force spectroscopy to investigate the role of vinculin in reinforcement of individual nascent adhesions during the first 5 min of cell contact with fibronectin or vitronectin. At minimal adhesion times (5-10 s), mouse embryonic fibroblast (MEF) wildtype (wt) and vinculin knock-out (vin(−/−)) cells develop comparable adhesion forces on the scale of several individual integrin-ligand bonds, confirming that vinculin is dispensable for adhesion initiation. In contrast, after 60 to 120 s, adhesion strength and traction reinforce quickly in wt cells, while remaining low in vin(−/−) cells. Re-expression of full-length vinculin or a constitutively active vinculin mutant (vinT12) in MEF vin(−/−) cells restored adhesion and traction with the same efficiency, while vinculin with a mutated talin-binding head region (vinA50I) or missing the actin-binding tail-domain (vin880) was ineffective. Integrating total internal reflection fluorescence imaging into the SCFS setup furthermore enabled us to correlate vinculin-green fluorescent protein (GFP) recruitment to nascent adhesion sites with the built-up of vinculin-dependent adhesion forces directly. Vinculin recruitment andcell adhesion reinforcement followed synchronous biphasic patterns, suggesting vinculin recruitment, but not activation, as the rate-limiting step for adhesion reinforcement. Combining sensitive SCFS with fluorescence microscopy thus provides insight into the temporal sequence of vinculin-dependent mechanical reinforcement in nascent integrin adhesions.

***Keywords****: Atomic Force Microscopy, Single-Cell Force Spectroscopy, Focal Adhesions, Cell Adhesion and Migration*

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# Genetically Encoded Fluorescence Lifetime Biosensors for Quantitative Imaging ofMetabolites in Live Cells

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**Abstract:** Fluorescence bioimaging has been a cornerstone in biological research, enabling visualizationof cellular metabolites, biomolecular interactions, and various biological processes. Since the developmentof the first $Ca^{2+}$ indicator in 1997, over 700 genetically encoded fluorescent biosensors have been createdto detect ions, metabolites, neurotransmitters, and other biological events. Traditional fluorescenceintensity-based biosensors sense their target based on changes in their fluorescence intensity. However, they face serval limitations such as dependence on expression level and excitation power, sensitivity to pH changes, susceptibility to photobleaching, and the influence from focus drift during timelapse imaging.These factors can lead to inconsistent and variable measurements, limiting their use to qualitative rather than quantitative assessment. In contrast, fluorescence lifetime biosensors, coupled with fluorescence lifetime imaging microscopy (FLIM), offer a more robust and reliable alternative. By measuring fluorescence lifetime rather than intensity, FLIM biosensors circumvent the issues of changes in expression levels, excitation power, and focus drift, and they also exhibit diminished sensitivity to pH and minimized photobleaching. This approach enables more reliable and accurate quantitative imaging. In this presentation, we will present our ongoing research in the development of genetically encoded fluorescencelifetime biosensors. We will introduce the strategies and methods used for converting fluorescence intensity-based biosensors into FLIM biosensors and share our progress with our current FLIM biosensorsfor ATP, GTP/GDP, and $Ca^{2+}$. These FLIM biosensors hold promise as invaluable tools for the precise and accurate study of cellular processes.

***Keywords****: genetically encoded fluorescence lifetime biosensors, FLIM, fluorescent proteins, bioimaging*

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# Oral Talks

# INVESTIGATION OF POLYMER-BASED HYDROGEL IN THE MANAGEMENT OF DIABETIC WOUNDS

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**Abstract:** According to the international diabetes federation, there are presently 351.7 million people of working age with diagnosed or undiagnosed diabetes in 2019. This number is expected to riseto 417.3 million by 2030 and to 486.1 million by 2045. The countries with the largest numbers of adults with diabetes aged 20–79 years in 2019 are China and India and are expected to remain so in 2030. Diabetes mellitus is a long-lasting condition that occurs when there are elevated levels of glucose in a person's blood because their body cannot produce a sufficient amount of insulin. Insulin deficit can cause damage to many vital organs, leading to disablingand life-threatening health complications such as cardiovascular diseases, neuropathy, kidneydamage and eye disease (leading to retinopathy and even blindness). In the current study, we hypothesized a polymeric hydrogel system for the management of diabetic wound healing. This biopolymer hydrogel was fabricated in the form of stretchable wound dressing material. The method consists of incorporating silver nanowires in a PVA-Gelatin hydrogel system for imparting stretchability and antibacterial activity. The varying concentrations of polyvinyl alcohol and gelatin were allowed to crosslink in the presence of a cross-linker at room temperature. The silver nanowires synthesized using the hydrothermal method were added to the PVA-gelatin gel (PG) to obtain PGA. The final gel was found to be highly stretchable and self-healable. *In vitro* antibacterial activity of PGA was tested on GFP-expressing E. coli cells and exhibited a significant cell death. *In vitro* cytotoxic activity was analyzed using cell lines and has shown no significant cytotoxicity. Results have shown better wound healing efficiencyin both in vitro and in vivo wound models with anti-bacterial effects.

***Keywords****: Diabetes, Wound healing, Hydrogel, Anti-bacterial, Stretchable*

# Dual light responsive chitosan nanocatalyst for photodynamic antibacterial therapy

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**Abstract:** Light responsive nanotechnology is a novel approach to develop simple, cost-effective, and advanced healthcare strategies to combat health care-associated infections (HAIs) caused due to various MDR (multi drug resistant) bacterial strains. Also, given the spasmodic increment in antibiotic resistance, world is on the verge of "post-antibiotic era". It is anticipated that the emergence of SARS- CoV2 pandemic would further worsen the situation in future, mainly due to paucity of new/nextgeneration of antimicrobials. Herein, we fabricate chitosan nano-assembly (CHPB-FD), for endogenous oxygen generation and enhanced combination phototherapy. CHPB-FD nano-assembly, is prepared by loading photosensitizer (fluorescein isothiocyanate-dextran , FITC-dextran) to chitosan coated Prussian blue (CHPB) .The interior PB core acts as a nanocatalyst ( catalase), facilitating the decomposition of hydrogen peroxide speeding up the oxygen supply synergistically amplifying the $O_2$ dependent therapeutic effect of photo dynamic therapy due to blue light irradiation . In addition to this, the PB core also acts as a photothermal agent increasing the local temperature upon red light irradiation with a photothermal conversion efficiency of 14.99%. This dual lights irradiation obliviates the competition at molecular level for the single light source and ensures complete photodynamic and photothermal efficiency. The novel system proves to be a highly versatile bactericidal material when tested against methicillin-resistant *Staphylococcus aureus* and pathogenic *Pseudomonas aeruginosa* growth with effective photosensitized inactivation. The local hyperthermia and photogenerated singlet oxygen accelerates amendment in intracellular metabolic pathways and bacteria killing. On the other hand, the catalse-like behaviour attenuates the levels of ROS. This robust antibacterial combination phototherapy utilizes few dosages, low laser flux, making it a potential platform to current antibiotic therapies against MDR infections.

***Keywords****: Antibacterial Photodynamic therapy, nanocatalyst, Photothermal therapy, Synergistic effect, dual phototherapy*

# Use of Functionalized Magnetic Nanoparticles for Rapid PCR-Based Detection of

# *Lactobacillus fermentum*, a Bacterial Contaminant in Ethanol Fermentation

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**Abstract:** Bacterial contamination in industrial yeast fermentation is a pervasive problem for beverage alcohol or commercial fuel ethanol production which can lead to the reduction in ethanol yield and considerable economic losses. Lactic acid bacteria (LAB) are the most troublesome because of their tolerance to high temperature and low pH, their ability to grow rapidly under high ethanol and low oxygenconditions during fermentation thus competing for sugars and nutrients. Lactobacillus fermentum has beenreported to be the most detrimental lactobacilli in fermentation causing 10% reduction in ethanolproduction.

Functionalized magnetic nanoparticles (MNP-F1) have high cell adsorption efficiency, can be used for rapid separation and concentration via magnetic field and reusable after magnetic separation. MNP-F1 was used in tandem with PCR to detect *Lb. fermentum* contamination in ethanol fermentation. It was revealed that the percent cell capture efficiency (%CCE) using 5 $mgmL^{-1}$ MNP-F1 on *Lb. fermentum* FM7at an initial population of $10^8$ $CFUmL^{-1}$ in MRS broth cultures ranged from 99.61% to 99.23%. Transmission Electron Microscopy well-validated the MNP-F1-*Lb. fermentum* FM7 conjugation of the target cells.

MNP-F1 promoted simple and rapid genomic DNA template preparation of captured cells

regardless of reagent-less, no culture enrichment and centrifuge-free gDNA extraction. Furthermore, successful detection of *Lb. fermentum* on MRS broth and actual ethanol fermenting molasses with *S. cerevisiae* BIOTECH 2030 in six MNP-F1 concentrations: 0.5, 0.25, 0.10, 0.05, 0.025 and 0.0125 $mgmL^{-1}$ were confirmed through PCR. Interestingly, 10 $CFUmL^{-1}$ cell concentration was also detected using the lowest MNP-F1 concentration of 0.0125 $mgmL^{-1}$ confirming the powerful applicability of MNP-F1, enhancing PCR detection limit from $10^4$ $CFUmL^{-1}$ to 10 $CFUmL^{-1}$ cells.

***Keywords**: Functionalized magnetic nanoparticle, PCR-based detection of LAB contamination, ethanol fermentation, percentcell capture efficiency, Lactobacillus fermentum*

# Establishment of multi-functional recombinant antibodies against tags, which adapts versatile biological applications

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**Abstract:** Antibodies have found extensive use across diverse applications in biological sciences. However, traditional IgG antibodies present several limitations, including ethical concerns related to animal-based generation, inconsistency from vendor to vendor, high cost, and challenges in adding functionalities. In contrast, recombinant antibodies (rAbs) have emerged as a superior alternative. They are animal-free, exhibiting enhanced reproducibility, cost reduction, and capably precise engineering for desired epitopes. Moreover, they can be tailored with additional functionalities through sequence engineering. Our focus centers on engineering rAbs fused to SpyTag, which enables rapid decoration with desired effectors via covalent linkage to the SpyCatcher partner within hours. In this research, we concentrate on rAbs targeting short sequences of peptides (around 15 amino acids), including HA, FLAG, SUN, PA, V5, Moon, ALFA, Pep, and GFP, in either nanobody or Fvclasp format. Our results exhibited the high specificity of our engineered rAbs in various assays, including Western blotting and immunofluorescence imaging, even under confocal microscopy. The compact size of nanobodies/Fvclasp format (~15-30 kDa) renders rAbs advantageous for cutting-edge technologies likehigh-resolution requirement in super-resolution microscopies, in contrast to the bulkier conventional IgG(~150 kDa). We also assessed the binding affinities of our rAbs using the HiBit-based quantitative immunoprecipitation assay, revealing Kd values ranging from 0.1 to 12 nM, indicative of strong binding to their targets. Our rAbs were also tested with profiling assay using a model of tagged CTCF (CCCTC- binding factor), a well-known genome regulator. The results demonstrated the comparable profile betweenour rAbs with the conventional IgG and published data. In summary, our data highlight the efficacy of producing rAbs in adapting to multiple biological applications. This approach offers advantages in affordable and rapidly generating antibodies with desiredfunctionalities from well-characterized components and the capability of enhancing specificity/sensitivityby reducing secondary antibody usage, stringent wash steps, and technical errors.

***Keywords****: recombinant antibodies, rAbs, antibody engineering, nanobodies*

# Investigation of the effect of ATP/ADP for formation of 2-Cysperoxiredoxin (Prx2) high molecular weight complex

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**Abstract:** Prx is an important antioxidant enzyme group in maintaining the physiological function of cells. Prx2 has been shown to lose its ability to degrade $H_2O_2$ by converting from peroxide to a spherical, high-molecular-weight (HMW) complex. The binding ability of Prx2 to negatively charged lipids (PS) and nucleotide (ATP/ADP) has been reported previously. To understand the formation mechanism of the HMW complex containing PS and ATP/ADP, we recently revealed PS binding site on Prx. However, ATP/ADP binding site on Prx2 remains unclear. Therefore, we investigated the ATP/ADP binding site in Prx2 using site-directed mutagenesis to understand the mechanism of the HMW complex formation.

***Keywords****: peroxiredoxins, oxidative stress, ATP/ADP, negatively charged lipid, high-molecular-weight complex*

# The Synthesis and Functional Assembly of T7 Replisome Machinery In *vitro* System

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An important in the construction of a genetically controlled synthetic cell is the replication of genomic DNA. In this study, we carried out to express and reconstitute all essential enzymes and cofactors of the bacteriophage T7 replisome complex in a cell-free transcription-translation system. We validated the expression of the helicase/primase encoding by the gp4 gene, T7 DNA polymerase encoding by the gp5 gene, single-strand DNA binding protein (SSB), and *E. coli* thioredoxin (trx). Using a combination of DNA replication substrates of dsDNA and ssDNA, we then confirmed the activity of the expressed enzymes and cofactors. The results indicated that, *in vitro* system, the expressed helicase with/without primase has activity on unwinding of dsDNA, the expressed T7 DNA polymerase has activity on DNA replication, the expressed trx has activity on the enhancement of T7 DNA polymerase activity, and the expressed SSB-dependent activity of DNA polymerase. The replication of long coding DNA coupled witha minimal gene expression in PURE system will be a crucial step toward the realization of a self-replicatingsystem. The functional reconstitution of a cell-free synthesized T7 replisome provides a novel and versatileplatform for single-molecule investigations and dynamic molecular assembly, that can be controlled in the minimal cell.

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***Keywords**:* Cell-free Transcription and Translation System, T7 replisome, single molecule, minimal cell

# Artificial synaptic vesicle for optical control of neurotransmitter with high spatiotemporal resolution

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**Abstract:** Optical control of bioactive molecules by the photocaging methods represents a valuable approach to investigate their role and dynamic interactions within cellular functions. The activity of the molecules is regulated by using photocleavable caging groups, which is removable from them in responseto light with a specific wavelength. Recently, we have achieved to synthesize caged acetylcholine (Ach) and optically control spatial concentration of Ach. However, a clear response of neuronal firing was not observed, likely due to the comparatively lower concentration of Ach released from the caged Ach in contrast to that released from a synaptic vesicle. Ach is stored in synaptic vesicles, which are organelles surrounded by a lipid bilayer membrane. These vesicles serve as transporters, efficiently carryingconcentrated Ach from vesicle pools to the synapse, where they facilitate the release of the neurotransmitter. With inspiration of this biological system, we hypothesized that optical control of Ach release from synaptic vesicles would allow triggering of Ach signaling on demand. Here, we designed near infrared (NIR)-triggered synaptic vesicle encapsulating Ach at a high concentration. The release of Ach from the vesicle was regulated by illumination with an NIR laser because the phase transition of thelipid membrane is induced by photothermal effect. To create these specialized vesicles, we conducted a microscopic study screening six photothermal dyes (PTDs). Among them, we identified a phthalocyanine-vanadyl oxide complex (VPc) as a promising candidate for the optical regulation of Ach release. VPc enabled rapid and controlled Ach release with 50 mseconds of NIR laser illumination. As a further demonstration of its potential applications, we successfully utilized this system for $Ca^{2+}$ imaging in cells of the Drosophila brain.

***Keywords****: photocaged method, neurotransmitter, acetylcholine, synaptic vesicle, lipid vesicle, photothermal conversion*

# Investigating the Post-harvest Preservation of Mango Using Nanocellulose and Chitosan in Vietnam

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**Abstract:** Mango (*Mangifera indica L.*) is a significant tropical fruit that boasts a delicate flavor,a pleasant aroma, and high nutritional value. In 2022, Vietnam produced 996 thousand tons of mangoes. But a large of mango is spoiled by microorganisms, lossed nutrition by respiration without preservation method. So, the main challenges that need to be addressed include the fruit's short shelf life, the difficulty in regulating post-harvest quality, and the lack of preservation technology. Chitosan is a polysaccharide, a strong antimicrobial (MIC is 0.1%). Nanocellulose has 3D complex morphology (typical fibril widths are 5–20 nanometers with a wide range of lengths, typically several micrometers) and high viscosity. Addition nanocellulose to chitosan improve viscosity and morphylogy of coating film. This study aimed to investigate how adding nanocellulose to chitosan could improve the postharvest quality and extend the shelf life of coated mango. The effects of various treatments, including 1% (w/v) nanocellulose (NC), 1% (w/v) chitosan (CTS), 1% (w/v) nanocellulose + 1% (w/v) chitosan (1% NC + 1% CTS), 1.5% (w/v) nanocellulose + 1% (w/v) chitosan (1.5% NC + 1% CTS), and 2% (w/v) nanocellulose + 1% (w/v) chitosan (2% NC + 1% CTS), on the storage quality of mango fruits were studied. The results showed that the NC + CTS treatment reduced weight loss, significant color change, and improved morphology, providing good nutrition for consumer health. The most effective treatment for morphology and slowest changing color was the 1% (w/v) NC + 1% (w/v) CTS. Moreover, the NC + CTS treatment improved the antimicrobial properties of mango fruits by increasing the activities of antimicrobial agents in chitosan, soluble viscosity, growth of microorganisms, and maintained color while delaying fruit senescence. Furthermore, the treatment provided excellent postharvest shelf-life to the fruits for seven days at 35 ± 2ºC. In summary, the NC + CTS treatmentwas an effective technique for maintaining the postharvest storage quality of mango fruits.

***Keywords**: antimicrobial, postharvest, nanocellulose, chitosan, coating film.*

# Application in cancer cell monitoring and point-of-care diagnosticsusing microfluidic devices

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**Abstract:** Microfluidic-based devices are related to micro-channels and chambers through which fluids flow in non-turbulent and highly ordered. Therefore, they have emerged as a powerful tool in all research fields, including chemical synthesis, biological analysis, and microbiology, based on their unique advantages. These benefits consist of much smaller reagent volume requirements, significant cost savings, faster reaction time, and enhanced analytical sensitivity. Although microfluidic platforms have been investigated and applied rapidly worldwide, it is still a new topic in Vietnam due to the limitation of the technology. This research paper presents the advances in cancer cell monitoring and point-of-care diagnostics concerning thecontribution of microfluidics. The realistic applications are also prove through low-cost and uncomplicated fabrication technique. In this way, the paper also presented some configurations and models of microfluidics used in single-cell analysis, drug delivery systems, etc, which belong to ongoing projects. Some outstandingresults, research directions, and challenges are discussed to open chances for research collaborations in developing microfluidic platforms.

**Keywords**: *Microfluidic, Single-cell analysis, Lab-on-chip, Point-of-care, Drug delivery systems.*

# Investigating the Post-harvest Preservation of Bananas Using Nanocellulose andChitosan in Vietnam

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**Abstract:** Vietnam is known as the center for bananas (*Musa* spp.) due to its favorable climate and conditions for growth and development. In 2021, the country produced 2.35 million tonnes of bananas, asignificant increase from the 475,000 tonnes produced in 1972. Bananas are a crucial staple fruit that playsa vital role in food security, contributing to increasing the income of farmers in rural and impoverished regions. However, improper post-harvest management practices can lead to significant economic losses for regions that produce bananas. This research aims to investigate the best post-harvest preservation of bananas using nanocellulose and chitosan solutions. The study tested different treatments, including 1% (w/v) nanocellulose (NC), 1% (w/v) chitosan (CTS), 1% (w/v) nanocellulose + 1% (w/v) chitosan (1% NC + 1% CTS), 1.5% (w/v) nanocellulose + 1% (w/v) chitosan (CTS) (1.5% NC + 1% CTS), and 2% (w/v) nanocellulose + 1% (w/v) chitosan (CTS) (2% NC + 1% CTS), to determine their effects on the storage quality of bananas. The results indicate that the 1% (w/v) nanocellulose + 1% (w/v) chitosan (1%NC + 1% CTS) treatment is effective in forming films, reducing weight loss, significantly changing color, improving morphology, and providing good nutrition for consumer health. The treatment also enhances the antimicrobial properties of bananas by increasing the activities of antimicrobial chitosan agents, soluble viscosity, and inhibiting the growth of microorganisms, as well as by maintaining color and delaying the senescence of fruits. Additionally, the treatment provides excellent post-harvest shelf-life tothe fruits for 7 days at 35 ± 2ºC. In conclusion, the 1% (w/v) nanocellulose + 1% (w/v) chitosan treatmentis a highly effective technique for maintaining the post-harvest storage quality of bananas.

***Keywords****: antimicrobial, postharvest, nanocellulose, chitosan.*

# Fibroblast growth factor 2-incorporated Carboxymethyl Cellulose Nanoparticles forBurned Skin Tissue Repair and Regeneration

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**Abstract:** Fibroblast growth factor 2 (FGF-2) is a multifunctional protein that plays an important role in wound healing. However, FGF-2 topical administration still has some limitations due to FGF-2 short half-life and instability. In this study, we prepared FGF-2-incorporated carboxymethyl cellulose nanoparticles(CMC:FGF-2 NPs) for FGF-2 stabilization and controlled release in burn treatment. Using ionic gelationmethod with $Al^{3+}$ as cross-linking agent, the CMC NPs (at the optimum NaCl:CMC:$AlCl_3$ weight ratio =66:10:1) were successfully prepared with spherical shape, non-clustered distribution, average size of 85.60nm, and no cytotoxicity on NIH/3T3 cell line. In FGF-2 incorporation, the CMC:FGF-2 NPs exhibited an average size of 88.00 nm without aggregation, FGF-2 loading efficiency over 90 %, and FGF-2 release rate of approximately 30 %. Besides, the NPs showed an efficient preservation of FGF-2 biological activityand a remarkable FGF-2 protection against protease hydrolytic action. In the study on third-degree burnedmurine model, the CMC:FGF-2 NPs highly accelerated the wound closure, re-epithelialization, granulation tissue formation, and angiogenesis compared to naked FGF-2 and FGF-2-unincorporated CMC NPs. Generally, CMC:FGF-2 NPs could potentially become a novel strategy for clinical applicationin burn treatment.

***Keywords****: carboxymethyl cellulose, fibroblast growth factor 2, ionic gelation, nanoparticles, tissue repair and regeneration, wound healing*

# Biomaterial actuator of M13 bacteriophage in tunable gap plasmonic color film fordiagnosing lung cancer

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**Abstract:** One of the most exciting plasmonic fields, the gap plasmonic coupling structures, is getting much attention in a wide variety of applications such as photonic sensors, biomedical and photonic applications as highly enhancing a large electric field near the surface of the nanoparticles and metal film.Meanwhile, a series of studies have attempted to control the gap distance structure based on various materials with unique characteristics. In these achievements, one of the popular applications is humidity sensors. Nevertheless, the inflexible properties of materials that lack wide sensitivity make it difficult to guarantee realistic application requirements. Therefore, the investigation into next-generation materials that can easily control the properties to tune reversibly the gap between nanoparticles with a metal film isstill challenging. In this study, we present the biomaterial from the M13 phage as an actuator in the dielectric layer to control the gap size at the nanoscale to tune the plasmonic resonance. The Ag nanocubeswere positioned on M13 phage self-assembled into nanostructures at a few nanometer-thick as a dielectric spacer to enhance the plasmonic resonance. The FDTD simulations of resonance peak and surface chargecontribution revealed that the coupling strength strongly depends on the M13 phage thickness. By exploiting the hydrophilic possibility based on the protein surface of the M13 phage, we demonstrated the dynamic tunability of the M13 phage layer through atomic force microscopy (AFM) under different humidity levels. Based on the mechanism gap plasmonic coupling system and the genetically engineeringM13 phage, we developed a colorimetric sensor array that detected VOCs gas, and lung cancer breath withhigh classification success rate.

***Keywords****: Lung cancer diagnosis, Breath analysis, volatile organic compounds (VOCs), gap plasmonic resonance, M13 bacteriophage*

# Concurrent session: Computational

# Invited Speakers

# Sampling the conformational transition of the monomer of Nsp15 of the SARS-nCoV2 gives a hint to inhibit its hexamer

Duy Phuoc Tran[1], Akio Kitao[1]

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**Abstract:** Nsp15 of plays an important role in endoribonuclease activity of the SARS-CoV-2 viruses. Here we reported our recent data on sampling the conformations of the Nsp15 in monomer state [1]. By using our developed method rmsdPaCS-MD with Markov state modelling (MSM), we found that the Nsp15 monomer exhibits as apo structure with larger in size of druggable pockets. We performed the virtual screening of ligands bound to that highest ranked pockets and found it is tightly bound to Nsp15 monomers by evaluating with binding free energy calculation using dPaCS-MD/MSM. Among of the poses, we found one has highly bound by inosine derivatives and tentatively to be the alternative bindingsite of the viral RNA.

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**Speaker:** Tran Phuoc Duy

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**Position: Assistant professor**

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**Short biography**:

Tran Phuoc Duy pursued the PhD at the Graduate School of Frontier Sciences of The University of Tokyo under supervision of Professor Akio Kitao. He then spent couple of years for post-doc at Tokyo Institute of Technology and The University of Tokyo before becoming Assistant professor at School of Life Science and Technology from April 2019 until now.

# Protein dynamics by the combination of high-speed atomic force microscopy and computational modeling

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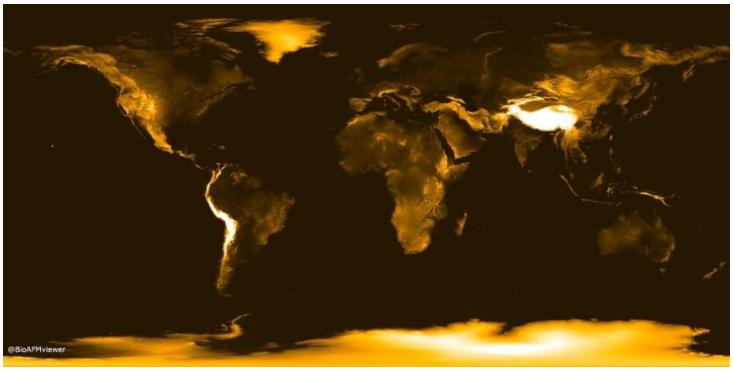
**Abstract:** High-speed atomic force microscopy (HS-AFM) allows direct observation of biological molecules in dynamic action. However, HS-AFM has no atomic resolution. In my talk I show how simulation atomic force microscopy and automatized fitting allows integration of atomistic-resolution structural and modelling protein data to facilitate the interpretation of resolution-limited AFM measurements [1,2]. Applications ranging from single proteins to filaments and protein lattices have been successfully demonstrated to advance the molecular understanding beyond original AFM topographic imaging. I will also present our BioAFMviewer software [3], which plays an important role in post- experimental computational analysis of experimental observations [4].




2D projection of the Earth as seen through a simulation microscope.
© Romain Amyot (BioAFMviewer)

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- since 2018, Assistant Professor @NanoLSI Kanazawa University, Japan
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- Dr. rer. nat. in Physics @Fritz Haber Institute of the Max Planck Society, Berlin, Germany

# AFM image computations by force calculation and combined studies of AFM andMD simulations

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**Abstract:** This talk will cover two topics. First, I will present how to compute topographic images of atomic force microscopy (AFM) and three-dimensional AFM (3D-AFM) images of biopolymers. Usual AFM images visualize isoforce surfaces where the force between the probe and the sample is constant, which are considered to be close to topographies. Accordingly, conventional AFM image simulations of biomolecules generally compute equidistance surface from atomic positions. As such, we have developeda method to really compute isoforce surface upon the biopolymers using a polymer simulation rather thangeometrical consideration.[1] It was found that the isoforce images were clearer than the equidistance ones,and very similar images to isoforce ones were obtained when the dimeter of the probe was reduced to approximately 30% in the equidistance images. 3D-AFM is a technology mapping forces in 3D space to resolve 3D distribution of samples. It was initially applied to water on a mica surface,[2] and recently to softand fluctuating biological molecules.[3] However, there was no theoretical method to compute 3D-AFM images of biomolecules, thus we have developed it using a polymer simulation.[4] To calculate forces duringapproach and retraction of the probe that generate nonequilibrium work, the Jarzynski equality was used. In the computed 3D-AFM images, some parts of fibers were resolved. Furthermore, it was clarified that there exists an optimum value for the vertical tip velocity. Second topics will be a study which combinedAFM measurements and the molecular dynamics (MD) simulations. I will talk about a novel gating mechanism of the $Na^+$ channel,[5] which is essential for nerve conduction. High-speed AFM (HS-AFM) visualized the dissociation of the voltage sensor domain (VSD) of the $Na^+$ channel and formation of a z- shape structure. With a comparison of a computed AFM image of the VSD dimer, generated from the trajectory of the MD simulation, it was clarified that the z-shape structure is a dimer of VSDs of differentchannels. This dimerization is a potential candidate to explain a rapid onset of the action potential.

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**Speaker:** Takashi Sumikama

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**Position:** Assistant professor

**Affiliation:** PRESTO, JST; Kanazawa University

**Short biography**: Takashi Sumikama got his Ph.D. in chemistry from Nagoya University. After spending two years as a postdoctoral fellow at Nagoya University and Institute for Molecular Science, and eight years as an assistant professor at University of Fukui, he joined NanoLSI at Kanazawa University. He is now a researcher at PRESTO, JST. His present interests are in building realistic chromosome models and the computational prediction of three-dimensional atomic force microscopy (3D-AFM) images and Hi-C maps of them for comparison with experiments. Another interest is analyzing molecular movies taken by high-speed atomic force microscopy (HS-AFM) and molecular dynamics (MD) simulations.

# Oral Talks

# Development of machine learning models for predicting antibiotic resistance in anintensive care unit of a Vietnamese hospital

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**Abstract:** *Background:* Antimicrobial Resistance (AMR) is one of the top global health threats, and it is particularly severe in intensive care units (ICUs) of hospitals in low- and middle-income countries. Machine learning (ML) has been used to predict AMR in ICU patients, but this has primarily been conducted in high-income countries. This paper aimed to develop and evaluate the performance of AMRpredictive models. *Methods:* In this retrospective cross-sectional study, data were extracted from electronic medical records of patients 18 years or older who had positive bacterial cultures from January 2020 to June 2022 in 175 Hospital. The data contained the information of 696 patients and 1576 non- duplicate bacterial specimens isolated in two hospitals. Several datasets were created with the data from complete blood counts and biochemical test results. Five algorithms and eight accuracy indicators were used to develop and evaluate the performance of AMR predictive models. *Results:* LightGBM, Random Forest, and XGBoost best performed AMR prediction models (sensitivity and accuracy: 0.780 - 0.990). The specificity was highest using XGBoost for the data with complete blood count. For the data with complete blood count and biochemical data, the indicator was highest using Random Forest. The most influential factors were the initial diagnosis and the time gap between admission and isolation. *Conclusion:* LightGBM, Random Forest, and XGBoost best predicted AMR. Sensitivity and specificity indicators varied by algorithms.

***Keywords****: AMR, Machine Learning, Infectious disease, Intensive care unit*

# Threshold selection in three-class classification problems with clustered data: anapplication to the discrimination of glutamatergic neurons types

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**Abstract:** Classification of subject's classes or types plays a key role in biosciences or medicine. For instance, distinguishing cancer patients from those without cancer or with benign cancers based on a diagnostic test or biomarker, helps doctors choose more effective treatments. Or in neuroscience, for elucidating the properties of neural circuits and how they lead to the generation of behaviors, neuroscientists are often requested to distinguish among the different cell types present in the mammalianbrain on the basis of gene biomarkers, typically measured using gene expression assays, such as single- cell RNA sequencing. In practice, however, not all classifiers are effective, so assessing the accuracy of aclassifier (or biomarker) is an important step before its eventual wide-scale use. After this step, if a biomarker has been shown to discriminate between classes, the next step involves the selection of an optimal threshold based on which a classification will be made. This process can be done quite easily fordata collected by a standard sampling scheme, where all study subjects are independent. In some cases, however, data can be collected by a complex design where individual units are naturally nested into clusters. This kind of data is referred to as clustered data. For example, the glutamatergic neurons of a mouse can come from the same genotype. In these cases, Bias can arise from omission, in the evaluation process and in the threshold selection, of cluster-level effects and/or individual covariates. Focusing on the three-class case and for continuous-valued biomarkers, we investigate how to exploit the clustered structure of data and provide a method for the statistical evaluation of biomarkers and then three methodsfor the choice of optimal thresholds. As an application, we study the use of the Lysosomal Associated Membrane Protein Family Member 5 (Lamp5) gene expression as a biomarker to distinguish among threetypes of glutamatergic neurons, namely Layer 2/3 Intratelencephalic (L2/3 IT), Layer 4 (L4) and Layer 5Pyramidal Tract (L5 PT) neurons.

***Keywords****: biomarker evaluation, optimal threshold, gene expression data, clustered data, receiver operating characteristic analysis*

# AutoEntangle: A Groundbreaking Insect Surveillance System Revolutionized byHarnessing Edge Computing Capabilities

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**Abstract:** The menace posed by fruit flies to fruit crops necessitates innovative solutions for safeguardingharvests. Our study presents an innovative solution to protect fruit crops from the menace of fruit flies. Our intelligent insect trap, equipped with advanced features and minimal resources on the Jetson Nano platform, achieves an impressive 83.6% F1 Score at a confidence threshold of 0.65, with an efficient meanprocessing time of 29ms per image and peak RAM usage of 2.4Mb per task. Demonstrating proficient detection and counting capabilities, the trap promptly notifies farmers of potential threats, enables targetedpesticide use in high fruit fly regions, reducing widespread spraying and ensuring crop protection. With an automatic adhesive plates replacement feature, it operates uninterruptedly without human intervention.This sustainable method, adaptable to various pests, optimizes resources and yield, proving invaluable inagriculture and beyond.

***Keywords****: fruit fly, environmental data, smart IoT, edge computing, FOMO, Jetson Nano*

# *In Vitro* Study of Flow Effects on Cellular and Plasma Proteins Behavior

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**Abstract:** Atherosclerosis is a condition that the arteries are narrowed down (stenosis), causing an obstruction in blood flow. Stenosis results in changes in pressure, wall shear stress (WSS), and flow characteristics, affecting the behavior of the vascular cells and proteins, such as endothelial cells and the von Willebrand factor. In some cases, flow reversal occurs, generating circulating flow. Nevertheless, thebiological effects of those dynamic blood flow changes have yet to be fully understood. Small-diameter blood vessels (< 5mm in diameter) are especially susceptible to atherosclerosis. Thus, this study analyzedfluid flow in the stenosis microfluidic models using Comsol Multiphysics 6.1 software. The microfluidic vessel models were 1mm in radius, half-cylindrical, rigid, and straight. The 80% stenosis trapezium-shape stenoses were employed with various stenosis lengths (0.1, 1, 2, and 4mm), trapezium acute angle (~10° and 20°), and stenosis type (round eccentric or concentric). The fluid used was PBS with an inlet velocityof 0.4m/s, corresponding to blood velocity in 2mm arteries. In parallel experiments, fibronectin (FN) structural changes under different flow conditions were studied. 500µg/ml FN in PBS was flowed througha µ-ibidi slide chamber under a range of shear rates, from abnormally low (~0.35$s^{-1}$) to physiologically high (~4000$s^{-1}$). The main results were that flow reversal occurred at post-stenosis in all models. Betweenthe eccentric and concentric models, the latter WSS is always approximately 1.5 times higher than the former. However, the turbulent kinetic energy was not affected by the stenosis type. Both the stenosis length and the acute angle significantly affected the turbulence and the reverse flow at the post-stenosis region. We recommend a high acute angle (≥ 20°) and stenosis length ≥ 2mm to maximize the flow eventfor *in vitro* study. For the FN flow assay, fibrilar FN (FFN) matrices were formed under abnormally low and physiological high shear stress conditions with various structures. These FFN show distinct effects on platelets and fibroblast cells than native FN. In future studies, the FN flow assay using new vessel models would allow the protein behavior assessment with multiple flow events.

***Keywords****: Computational Fluid Dynamics, Flow Reversal, Microfluidics, Stenosis, Wall Shear Stress*

# Plasma cell-free RNA Profiling of Vietnamese Alzheimer's patients revealsa Linkage with chronic inflammation and Apoptosis: A pilot study

Thien Hoang Minh Cao[*1], Anh Phuc Hoang Le[*1], Tai Tien Tran[2], Vy Kim Huynh[1], Bao Hoai Pham[1], Thao Mai Le[1], Hang Nguyen[1], Quang Lam Nguyen[1], Thang Cong Tran[4], Trang Mai Tong[3], The H. N. Than[3], Tran T. T. Nguyen[3], Huong T. T. Ha[1,#]

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**Abstract:** Circulating cell-free RNA (cf-RNA) is a potential hallmark for early diagnosis of Alzheimer's Disease (AD) as it construes the genetic expression level, giving insights into the pathological progress at the outset. Profiles of cf-RNA in Caucasian AD patients have been investigated thoroughly, yet there was no report inspecting changes in the ASEAN groups. This study examined the gap, expecting to support the development of point-of-care AD diagnosis.

cf-RNA profiles were characterized from 20 Vietnamese plasma samples (10 probableAD and 10 age-matched controls). RNA reads were subjected to differential expression (DE) analysis, followed by weighted gene correlation network analysis (WGCNA) to cluster genes (modules) that significantly co-expressed with one another. These modules were then correlated with AD diagnosis to identify relevant modules. The hub genes - potential drivers ofeach module - were spotted by cytoHubba via Maximal Clique Centrality (MCC) score ranking.

136 genes were identified as significant AD hallmarks ($p < 0.05$), with 52 downregulated and 84 upregulated in the AD cohort. 45.6% of these genes are highly expressedin the hippocampus, cerebellum, and cerebral cortex. Notably, all markers related to chronic inflammation were upregulated, and there was a significant shift in all apoptotic markers. Threeout of five co-expressed modules were found to be significantly correlated with Alzheimer's status ($p < 0.05$; R^2 > 0.5). Functional enrichment analysis on these modules reveals an association with focal adhesion, nucleocytoplasmic transport, and cytoplasmic translation pathways, suggesting the potential participation of these pathways in AD pathology. 15 hub genes were found to be differentially expressed genes with the highest connectivity. Many of these hub genes are associated with inflammation, apoptosis, and signaling (FOXO1, ZFAND6,SASH1, TAOK3), indicating their potential role as key drivers in AD gene expression.

***Keywords:*** *Alzheimer's disease, Molecular biomarkers, Cell-free RNA, inflammation, apoptosis.*

# Revealing the heterogeneity of plasma protein and cognitive decline trajectory among Mild Cognitive Impairment patients by clustering of brain atrophy features

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**Abstract:** Recent studies suggested that Alzheimer's disease (AD) is a heterogeneous disorder, presentingdifferences in developing patterns of brain atrophy. Therefore, this study aimed to tackle this problem byusing cluster analysis to investigate the heterogeneity in structural brain changes and plasma biomarkers of the early stage of Alzheimer's disease (AD): Mild cognitive impairment (MCI). In this study, the baseline MRIs of MCI patients underwent preprocessing with Freesurfer to extract brain features. Subsequently, the extracted features were clustered using the CIMLR (Cancer Integration via Multi-kernel Learning) algorithm. The demographic and cognitive characteristics, brain atrophy, plasma biomarkers, and longitudinal cognitive trajectory were analysed for each cluster. The CIMLR clustering analysis revealed four distinct clusters, with some sub-groups exhibiting atrophy patterns inconsistent with the Braak stage. Cluster 1 is the oldest group with mild atrophy and moderate progression with elevated TumorNecrosis Factor Receptor 2 levels, Brain-Derived Neurotrophic Factor, and CD40 Ligand. Cluster 2 showed the highest risk for aggressive MCI progression, with abnormal Leptin, Adiponectin, and Creatine kinase-MB values. Cluster 3 exhibited a high level of CD40 Ligand and mild atrophy that shared similar patterns with Cluster 1. Cluster 4 represented the healthiest group during longitudinal tracking, with the mildest Parahippocampal atrophy, which was found to be positively correlated with cognitive impairment and amino acid levels. The study also identified several factors that can alleviate or worsen the progression of the MCI including lipid and amino acid metabolism, cardiovascular diseases, inflammatory modulators,and glial activations. The longitudinal analyses showed the potential of Hepatocyte Growth Factor as a marker for slow cognitive impairment; Cortisol and Neurofilament Light Polypeptide as prognosis markers for aggressive MCI progression. These findings may lay out new suggestions for further researchcontributing to the accurate diagnosis and precision medicine for dementia and AD.

***Keywords****: Alzheimer's disease, Mild Cognitive Impairment, MRI, Artificial Intelligence, Clustering*

# Interaction of curcumin molecule with fullerene material by simulation method

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**Abstract:** The designs of target-drug delivery systems are attractively concerned due to their efficacy and safety. Fullerene is the first symmetrical carbon nanomaterial invented in the world. Due to the special properties of fullerene, it is an emergent topic in nanomaterials in recent years. Many experimental studies used this material to form the drug-carrier system and have shown a significant improvement in the pharmacokinetic properties of the active substance. Curcumin is a natural compound extracted from turmeric, with many pharmacological properties such as antiviral, antibacterial, and impact on cancer cells, etc. However, curcumin's pharmacological properties are hardly clinically demonstrated due to its water-solubility. A fullereo-curcuminoid derivative to HIV viruses and cancer cells was created, in which curcumin is out-bound to fullerene. HIV antiviral properties showed only moderate efficiency, and no anti-cancer effect was observed. Another disadvantage of the out-bound fullereo-curcuminoid derivative is that it is hard to control the numberof curcumin-derivative molecules that bind out-surfaced fullerene, which is a critical problem we needto deal with since curcumin overdose causes side effects to the digestive system, skin, or headache.For the above reasons, we decided to conduct this research, focusing on the computational approach ofin-bound fullereo-curcuminoid derivative systems for drug delivery, with adequate fullerene size to encapsulate curcumin molecules. This proposed model is promising not only to create a better anti- solvent shield for the curcumin molecule throughout the delivery path to the target cells but also to manipulate the curcumin dose since the fullerene shield may increase the efficiency of curcumin carrying. This research uses the computational simulation method to investigate the epidermal growth factor (EGF) receptor binding and the physicochemical parameters of the curcumin molecule encapsulated in fullerene. The density functional theory (DFT) calculation is conducted to observe the electrical and energetic properties of the curcumin-fullerene encapsulation system. The obtained system is then docked with the target receptor. After that, the size-modified defected gap will be created on the fullerene surface in the release process of the curcumin out of the fullerene. To interact with the target residues on the receptor will be observed by using MD simulation and their interactionstabilization.

***Keywords**: fullerene, curcumin, drug delivery, molecular dynamic simulation*

# Investigation of the binding properties of several ligands with the main protease ofSARS-CoV-2

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**Abstract:** The COVID-19 pandemic has weakened so far; however, there is still a risk of emerging new virus strains, and researching drugs to treat the SARS-CoV-2 virus is crucial. Therefore, in this report, I investigate two potential compounds targeting the main protease (Mpro) of the SARS-CoV-2 virus in dimeric form to inhibit the viral replication process: X77 and Amentoflavone (AMF), using molecular docking and molecular dynamics simulations. Through a 300ns simulation, we observed that both X77 and AMF molecules stably bind to the active site of SARS-CoV-2 Mpro with high binding affinities (-8.5and -9.7 kCal/mol). The main types of interactions between the ligands and residues within the active siteof SARS-CoV-2 Mpro are electrostatic and van der Waals forces. Furthermore, the structure of the complex formed with these ligands is more stable compared to the structure of the complex without ligandbinding. These results demonstrate that X77 and AMF compounds have the potential to inhibit the activityof the SARS-CoV-2 Mpro protein, providing a foundation for screening potential compounds to cope withnew variants of the coronavirus.

***Keywords****: COVID-19, Main protease inhibitors, X77, Amentoflavone, Molecular docking, Molecular dynamics simulation, insilico drug design*

# Posters

# Expression and Functional Assembly of Essential Enzymes and Cofactors of the T7Replisome in Cell-free Transcription and Translation System

Ngoc Huong Hoang[1], Nguyet Anh Thi Bui[2], Quynh Huong Thi Bui[1], Nhi Van Pham[4], Tra Huong Thi Nguyen[5], Pauline vanNies[3], Ilja Westerlaken[3], Christophe Danelon[3] and Huong Thi Bui[2,3,5]*.

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**Abstract:** The replication of genomic DNA is important for the construction of a genetically controlled synthetic cell. In this study, we carried out to reconstitute *in vitro* the multi-protein T7 replisome complexstarting from the genes encoding for all essential enzymes and cofactors of the helicase/primase (gp4), theT7 DNA polymerase (gp5), the single-strand DNA binding protein and the *E. coli* thioredoxin (trx), and to express them in a cell–free transcription and translation system were carried out. We indicated the activity of the various proteins including: enhancement of gp5 polymerization by trx (Fig.1), gp2.5 - the dependent activity of gp4 (Fig.2), the unwinding of DNA duplex by gp4 with and without gp5 (Fig.3), theenhancement of polymerase activity by gp2.5 (Fig.4), and the rolling circle reaction (RCR) by the complexof gp4 and gp5/trx from dsM13 template (Fig.5). The functional reconstitution of an *in vitro* synthesized T7 replisome provides a novel and versatile platform for single-molecule investigations, where the dynamic molecular assembly can be examined as a function of varying concentrations of specific partners. The replication of long coding DNA coupled with a minimal gene expression system will be a crucial steptoward the realization of a self-replicating system.

***Keywords**: Cell-free Transcription and Translation System, T7 replisome, single molecule*

# Advances in research and development of electrochemical nanosensors based onon multifunctional nanomaterials

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**Abstract:** The impressive development of electrochemical sensors has been recorded by using various nanomaterials to modify electrode surfaces. In some of our recent research, the utilization of 0D (magneticspinel oxides or noble metallic nanomaterials), 2D (graphene, GO, and $MoS_2$, and 3D (Metal–organic frameworks-MOFs) nanomaterials, particularly novel functional hetero-nanostructures for electrochemical sensors has offered many positive results. A series of physicochemical andelectrochemical characteristics at the modified electrodes have been improved remarkably, for example, EASA value, electron conductivity, electrocatalytic ability, adsorption capacity (Γ), and diffusion ability, leading to enhance performance towards toxic chemicals detection in foods and environment. Mechanismsand hypotheses for these great enhancements have been proposed, demonstrating the important role and outstanding impacts of nanomaterials at the electrode surface.

***Keywords**: Electrochemical Sensors, Functional Hetero-nanostructures; Nanomaterials; Surface Modification; Residue Detection*

# Synthesis and Characterization of a Phthalocyanine Dye with Phosphonate Moiety

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**Abstract:** Phthalocyanine is a near infra-red dye used in photothermal therapy that can convert light energy to heat energy. However, achieving the required photothermal conversion efficiency, along with cell penetration and retention, remains challenging for biological studies. The tuning of polarity is necessary to maintain a balance between cell penetration and retention. In previous research, sulfonic acidhas been utilized to overcome this challenge. However, more hydrophilic nature of the sulfonic group hasinterfered the cell penetration ability. In contrast, the phosphonate group shows greater promise. This is because acetoxymethyl group can be easily added to the phosphate, allowing subsequent modifications toachieve the required hydrophobicity for cellular membrane penetration. Moreover, cell retention can be achieved through enzymatic cleavage of acetoxymethyl group inside cells. In this study, we successfully synthesized a water-soluble phthalocyanine dye with a phosphonate moiety. Our investigation focus on evaluating the properties of this water-soluble phthalocyanine, including its pH dependency, aggregation tendency, and photothermal efficiency. Results indicate favorable water solubility at pH 10-14, yet aggregation propensity in acidic conditions. This investigation aims to optimize molecular designs for enhanced photothermal therapy through improved cellular delivery and retention.

***Keywords****: Photothermal therapy, Phthalocyanine, Water solubility, Phosphonate, Bioimaging*

# An imaging tool for quantifying intracellular GTP levels in live cellsusing a fluorescence lifetime-based biosensor

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**Abstract:** Intracellular GTP affect the activities and functions of various GTP-binding proteins which regulate multiple cellular processes, including protein synthesis, cell growth, and proliferation. Understanding these biological activities require measuring GTP concentration in living cells, however, tools for accurately detecting GTP levels arelimited. Here, we engineered a fluorescence lifetime-based biosensor by fusing a GTP- binding domain into circularly permuted enhanced yellow fluorescent protein, providinga tool to measure intracellular GTP levels. This sensor, named FLIM-GTP, enables quantitative imaging by fluorescence lifetime imaging microscopy (FLIM). The responseof FLIM-GTP was by about 0.6 ns in fluorescence lifetime following GTP binding. FLIM-GTP promises to be a potential tool for monitoring GTP levels in live cells. In thisposter, we will further discuss its capabilities in a variety of cellular applications.

***Keywords:*** *GTP, FLIM, biosensor, fluorescent protein*

# Smart Electrochemical Sensors for Detection of Antibiotics in Food and Pharmaceutical Samples

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**Abstract:** The overuse of synthetic antibiotics and pesticides in farming and ranching management is creating an increasing threat to ecosystems and human health. Accordingly, electrochemical sensor and biosensor platforms have emerged as effective analytical tools for detecting antibiotics and pesticides dueto a number of benefits, such as simplicity of detection, significant sensitivity, and selectivity. Smart electrochemical devices have been fabricated recently for the detection of antibiotic and pesticide residuesby integrating nanostructured materials and controlling strategies by external factors, including the field of electric, magnetic, light, and so on. These advances aimed to improve intrinsic electrochemical properties, namely electrocatalytic activity, adsorption/diffusion capacity, and electrical conductivity. Wehave developed novel nanomaterials such as spinel oxide, 2D nanostructures, and hetero-nanostructures to construct the smart electrochemical sensors. Several of light-assisted and magnetic field-assisted electrochemical sensors can detect extremely sensitive and have wide concentration ranges for antibiotics like chloramphenicol, furazolidone, paracetamol, and ofloxacin. These insights obtained offer new opportunities for the development of electrochemical sensors. These insights obtained offer new opportunities for the development of electrochemical sensors.

***Keywords****: Electrochemical sensor, spinel oxide, hetero-nanostructure, antibiotic, pesticide*

# Nanocarrier Utilizing Cubic-Shaped Liposomes for Near Infrared Light-Responsive On-Demand Drug Delivery System

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**Abstract:** Effective cancer treatment hinges on the delivery of drugs to target sites while minimizing side effects. Recent years, light triggered on-demand release systems garnered attentions as a promising drug delivery approach that utilizes light as an external stimulus to control the release of drugs from nanocarriers. Among these systems, the near infrared (NIR) operated system stands out asa practical one as NIR light exhibits high tissue penetration and low phototoxicity. This enables the accurate controlled release of drug molecules in the body. Here we present a NIR-operated liposomal system using cubic-shaped liposomes. These liposomes exhibit a phase transition temperature at 37- 39°C, facilitating the controlled release of drugs in response to the local heat delivered by NIR light. In addition, while the 2-Deoxy-D-glucose (2-DG) was encapsulated as a glycolytic inhibitor, the liposome is modified with iRGD peptide and then can be released directly to cancer cell or tumor site.Firstly, in vitro experiments, combining the NIR-light operated system with 2-DG encapsulation demonstrate controlled drug release, leading to an effective reduction in cancer cell viability. It was assumed that, when NIR was illuminated to liposomes and the lipid bilayer got loosen at the phase transition temperature, immediately encapsulated 2-DG was released inside the cell, resulting in the anti-tumor effect due to the inhibition of glycolysis. Remarkably, treatment of 2-DG-liposome facilitated by the NIR-light system, yielded a 0.9% cell viability surpassing controls. In animal studies, external NIR irradiation triggers precise drug release, culminating in significant tumor shrinkage—29%reduction in tumor diameter and 5% reduction in volume compared to controls. NIR system can shrink tumors without the need to dissect the mouse, providing an opportunity to treat diseases in large animals or human. In this poster, the detailed of cell death will be addressed, too.

***Keywords****: cubic-shaped liposome, NIR-operated drug delivery system, NIR light, 2-DG, controlled drug release*

# Design of a new electrochemical sensing system based on $MoS_2$-AuNPs composite for the detection of Paracetamol

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**Abstract:** In the present study, gold nanoparticle-decorated molybdenum disulfide ($MoS_2$) nano-particles via the hydrothermal process. The crystallite size, shape, and morphology of $MoS_2$-Au material were characterized by X-ray diffraction pattern (XRD), field emission scanning electron microscopy (FESEM), and energy-dispersive X-ray spectroscopy (EDS) techniques. These particles were utilized as electrodes modified with Screen-printed electrodes (SPE) for the detection of paracetamol (Para) in pharmaceuticalsthrough Cyclic voltammetry (CV) and Differential pulse voltammetry (DPV) techniques. A linear relationship between the anodic current of Para concentration was obtained over the range of 0.156 to 75µM with a detection limit of 89 nM. The proposed method was simple, less time-consuming, and showedhigh sensitivity. The application of this electrode to determine Para in tablet samples. The results analyzedby the proposed method were not significantly different from the content stated on the label pharmaceutical. The electrodes demonstrated satisfactory results in real samples of pharmaceuticals.

***Keywords****: Paracetamol, Cyclic voltammetry, Differential pulse voltammetry, pharmaceuticals, $MoS_2$-Au.*

# Nanomagnetic particles detection using Tunneling Magnetoresistance (TMR) Sensors and lock-in amplification technique

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**Abstract:** A popular application of magnetic nanoparticles (MNPs) in biosensing is due to their abilityto be coupled with specific antibodies. To determine the amount of biological entities, the magnetic susceptibility of MNPs can be measured after the coupling. But it is not easy to detect the magnetic stripes with mm width containing magnetic nanoparticles. We propose a non-contact scanning method todetect metal stripes with mm size. The sensor consists of a TMR magnetic sensor and an amplifier circuit using lock-in technique to amplify the signal. The device was tested by using metal stripes with a diameter of 2 mm and a length from 2 to 10 mm. The results show that the output signal is proportional to the length of the stripe. These results indicate that this device can detect small magnetic materialssuch as metal stripes or nanoparticles for future biological applications.

***Keywords****: magntic nanoparticles, tunneling magnetoresistance (TMR) sensor, lock-i n amplifier, antibodies, non-contact scanning*

# Study on shape memory effect and drug release of composite membranes based onelectrospun poly(ε-caprolactone)/polyethylene glycol nanofibers

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**Abstract:** Shape memory polymers (SMP) are a class of smart polymers with potential applications in biomedical fields such as wound monitoring, tissue engineering scaffolds, smart controlled drug release, and intelligent medical devices. In this study, poly(ε-caprolactone) (PCL)/polyethylene glycol (PEG) containing different amounts of zinc oxide (ZnO) nanoparticles and graphene oxide (GO) were electrospunto form nanofiber membranes having shape memory effect. The results showed that the composite membranes exhibited excellent shape-memory performance under temperature actuation. The composite nanofibers membrane containing 0.5 wt% ZnO nanoparticle and 1.0 wt% GO exhibits the best shape- memory performance with the fixation ratio ($R_f$) and the recovery ratio ($R_r$) could be as high as over 95% and 80%, respectively. Further, the PCL/PEG/ZnO/GO shape memory membrane could be a carrier of a natural antibacterial agent, berberine (BBR). The effectiveness of applying this PCL/PEG/ZnO/GO/BBR composite membrane, like a smart controlled drug delivery system under temperature actuation, was determined. The composition, the morphology, and the thermal stability of the composite membranes were characterized using Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), and differential scanning calorimetry (DSC). The study is expected to provide a new shape-memory material that can control drug release and broaden the application area of shape memory material in biomedical fields.

***Keywords****: Shape memory materials, nanofiber, electrospinning, drug release, poly(ε-caprolactone).*

# Enhanced solubility and antibacterial ability of nanoformulized berberine nanoparticles against hospital-acquired infections

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**Abstract:** The poor water solubility of the phytochemicals limits their development in the pharmaceutical industry. This study aims to prepare berberine (BBR) in nanoformulation to enhance its solubility and increase its antibacterial effectiveness against hospital-acquired infections. BBR nanoparticles (BBR NPs) were formed by antisolvent precipitation (ASP) using glycerol as a safeorganic solvent. The solubility of BBR NPs was greatly enhanced compared with that of pure BBR. Glycerol played a role as a stabilizer for BBR NPs because of the existence of hydrogen bonds between glycerol and BBR NPs. The prepared BBR NPs have a narrow distribution of nanoscale size with an average diameter of 156 at concentrations of 2.0 mg/mL. The concentration of BBR NPs could reach up to 5.0 mg/mL, which was higher than the saturation concentration of pure BBR. Results showed a strongly enhanced antibacterial activity of BBR NPs compared with pure BBR at the same concentration. The minimum bacterial concentration of BBR NPs against methicillin-resistant *Staphylococcus aureus* (MRSA) and *Escherichia coli* (*E. coli*) O157:H7 was found at concentrations of 2.0 and 5.0 mg/mL, respectively. Therefore, BBR NPs prepared by the ASP appear to be a potential candidate for the treatment of bacterial pathogens.

***Keywords**: BBR NPs, glycerol, solubility, ASP, antibacterial activity*

# Aminated hollow mesoporous silica nanoparticles as an enhanced loading and sustained releasing carrier for doxorubicin delivery

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**Abstract:** Mesoporous silica nanoparticles (MSNs) has been known as a potential delivery system for doxorubicin (DOX). However, they have restricted applications due to uncontrolled leakage, burst releaseof open pores, and limited loading content of non-hollow core. In this study, a simple and effective systembased on hollow MSN (HMSN) was synthesized and amino-functionalized in order to optimize loading capacity and improve the release profile for DOX delivery. HMSNs were prepared following sSiO2 hardtemplate preparation, mesoporous silica layer coating, and core template etching. Then the nanoparticles were aminated by (3-aminopropyl)-triethoxysilane (APTES) at different concentrations. Successful aminofunctionalization was shown by FT-IR, XPS, and TGA. The surface area was revealed by BET and surface charge was determined by Zeta potential. TEM images showed high uniformity of spheres with hollow core-mesoporous shell structure and 154.0 ± 0.9 nm diameter of the aminated HMSN (HMSN-$NH_2$), whilst the optimal –$NH_2$ amount on aminated HMSN surface was found to be 80.17 µg/100 mg by Kaisertest. After being aminated, HMSN-$NH_2$ performed a 3.63-fold increase in DOX loading content and a 1.50-fold decrease in cumulative DOX after 48 h. Additionally, MTT assays indicated HMSN-$NH_2$ was a biocompatible nanocarrier that had no toxicity on human hepatocellular carcinoma J5 (HCC J5) cells. The results suggested that the synthesized HMSN-$NH_2$ could be a great potential nanocarrier in cancer therapy with optimal loading content and sustained release of DOX.

***Keywords**: Hollow mesoporous silica nanoparticle (HMSN), amino functionalization, (3-aminopropyl)-triethoxysilane (APTES), Doxorubicin (Dox), drug delivery*

# Single-molecule investigation of the binding interface stabilityof SARS-CoV-2 variants with ACE2

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**Abstract:** The novel coronavirus SARS-CoV-2 has caused a global pandemic, and much research is being done to understand the viral infection and find ways to combat it. One important aspect of this research is the study of the binding interface between the virus and human receptors. This interface plays a crucial rolein virus transmission and pathogenicity and therefore is a potential target for therapeutic intervention. In thisstudy, the binding interface between the receptor binding domain (RBD) of SARS-CoV-2 and the angiotensin-converting enzyme 2 (ACE2) receptors was investigated using atomic force microscopy and steered molecular dynamics. The aim was to understand the impact of variants of concern on the binding affinity between RBD and ACE2. Results showed that some of the latest variants have a stronger binding affinity, leading to the possibility of immune escape. The findings of this study provide important insights into the dynamics of the RBD/ACE2 interaction and can mediate the development of new strategies for combating SARS-CoV-2. This research highlights the importance of continued monitoring and study of thevirus and its variants to effectively control its spread and minimize its impact on public health.

***Keywords****: SARS-CoV-2, ACE2, RBD, Variant, Omicron, Delta, Mu, force, AFM, atomic force microscopy, Contact map analysis, free energy, Jarzynski equality, energy, structure, neutralization, biolayer interferometry, BLI, convalescent patient, sera, antibody.*

# Creation of a gel-emulsion complex form containing curcumin, gelatin, and nanosilver (GelCurAg) and investigation of the antibacterial, and antioxidant activity of the complex

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**Abstract:**.Curcumin is a compound derived from *Curcuma longa* that has numerous pharmacological properties and is used to support the treatment of a variety of diseases such as cancer, diabetes, chronic kidney disease, metabolic diseases, and cardiovascular problems. However, curcumin has poor solubilityand bioavailability. Therefore, in this study, curcumin was prepared in a gel-emulsion complex form containing gelatin and nanosilver (GelCurAg) to enhance the dispersion, stability, and biological activityof this complex in solution. The physical, chemical, and morphological properties of the complex were determined by UV-vis spectroscopy, FTIR spectra, and SEM electrical microscopy images. Gel0.1CurAgcomplex has antioxidant activity with an $IC_{50}$ value of 4.8 µg/mL and is also active against bacterial strainsincluding *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 25923, and *Pseudomonas aeruginosa* ATCC 27853 with zones of inhibition of 1.5±0.1, 1.1, and 1.1±0.05 cm.

***Keywords****: Curcumin, nano silver, gelatin, antibacterial activity, antioxidant activity*

# Silver Nanoparticles Green Synthesized Using Aqueous Extract of *Cnidium monnieri*

# Fruit and Its Antibacterial Activity

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**Abstract:** Plant secondary metabolites have biological activities and can be used as reducing agents in thebiosynthesis of silver nanoparticles. The present study uses *Cnidium monnieri* (CM) fruit extract to reducesilver nitrate to silver nanoparticles (AgNPs). The synthesis of nanoparticles was confirmed by detectionin UV-visible spectroscopy and changing color from a colorless solution to a brown-colored solution. Thenanoparticles were characterized by Ultraviolet spectroscopy, X-ray diffraction, transmission electron microscopy, and FTIR analysis. The antibacterial activity was determined using disk fusion assay by measuring the diameter for the zone of inhibition. AgNPs capped the CM extract (CM-AgNPs) showed roughly spherical geometry with an average diameter of 5.6nm. In addition, CM-AgNPs strongly inhibitedtwo tested microorganism strains. Therefore, the CM-AgNPs have the potential for antibacterial agents.

***Keywords***: *Cnidium monnieri, silver nanoparticles, antibacterial activity, biosynthesis*

# Silver Nanoparticles Green Synthesized Using Aqueous Extract of *Helicteres hirsuta* Lour Leaf and Its Antibacterial Activity

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**Abstract:** *Helicteres hirsuta* was reported that has high phenolic, saponin, and flavonoid content. Those compounds have strong antioxidant activity that can be used as reducing agents in the biosynthesis of silver nanoparticles. The present study uses *Helicteres hirsuta* (HH) leaf extract to reduce silver nitrate tosilver nanoparticles (AgNPs). The synthesis of nanoparticles was confirmed by detection in UV-visible spectroscopy and changing color from a colorless solution to a brown-colored solution. The nanoparticles were characterized by Ultraviolet spectroscopy, X-ray diffraction, transmission electron microscopy, and FTIR analysis. The antibacterial activity was determined using disk fusion assay by measuring the diameter for the zone of inhibition. AgNPs capped the HH extract (HH-AgNPs) showed roughly spherical geometry with an average diameter of 7.2nm. In addition, HH-AgNPs strongly inhibited two tested microorganism strains. Therefore, the HH-AgNPs have the potential for antibacterial agents.

***Keywords****: silver nanoparticles, antibacterial activity, Helicteres hirsuta, biosynthesis*

# Evaluation of Potential Anti-Bacteria of Luminescent carbon quantum dots from Orange juice using Microplasma Treatment

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**Abstract:** Carbon dots (CDots) with a size of less than 10 nm can be applied in lots of biomedical and different research fields. The characteristics of CDots and evaluating their antimicrobial activity with the simple and eco-friendly synthesized processes from orange juice as a precursor have been reported. The CDots was prepared by the plasma process method which can be found to be spherical particles and well distributed with an average size was about 3 nm. The photoluminescence properties of the CDots were investigated in detail. It is observed that the fluorescence emissions of CDots shifted to a higher wavelength with the excitation wavelength increases. These results are due to the size of the CDot and on the surface of the CDots appearance of carboxyl and hydroxyl functional groups which confirms by the Fourier-transformed infrared spectrophotometer. The anti-microbial assay of CDots was investigated versus escherichia coli and staphylococcus aureus. The minimum inhibitory concentration of CDots for both strains of 50 µg/mL. The bacterial membrane destabilization with the treatment of CDots led to the oxidative stress generated, which exhibits properties against bacteria.

***Keywords***: *Carbon dot, Surface alteration, Antibacterial, Optical properties, Escherichia coli*

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