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The Chinese University of Hong Kong

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香港中文大學(深圳)
The Chinese University of Hong Kong, Shenzhen

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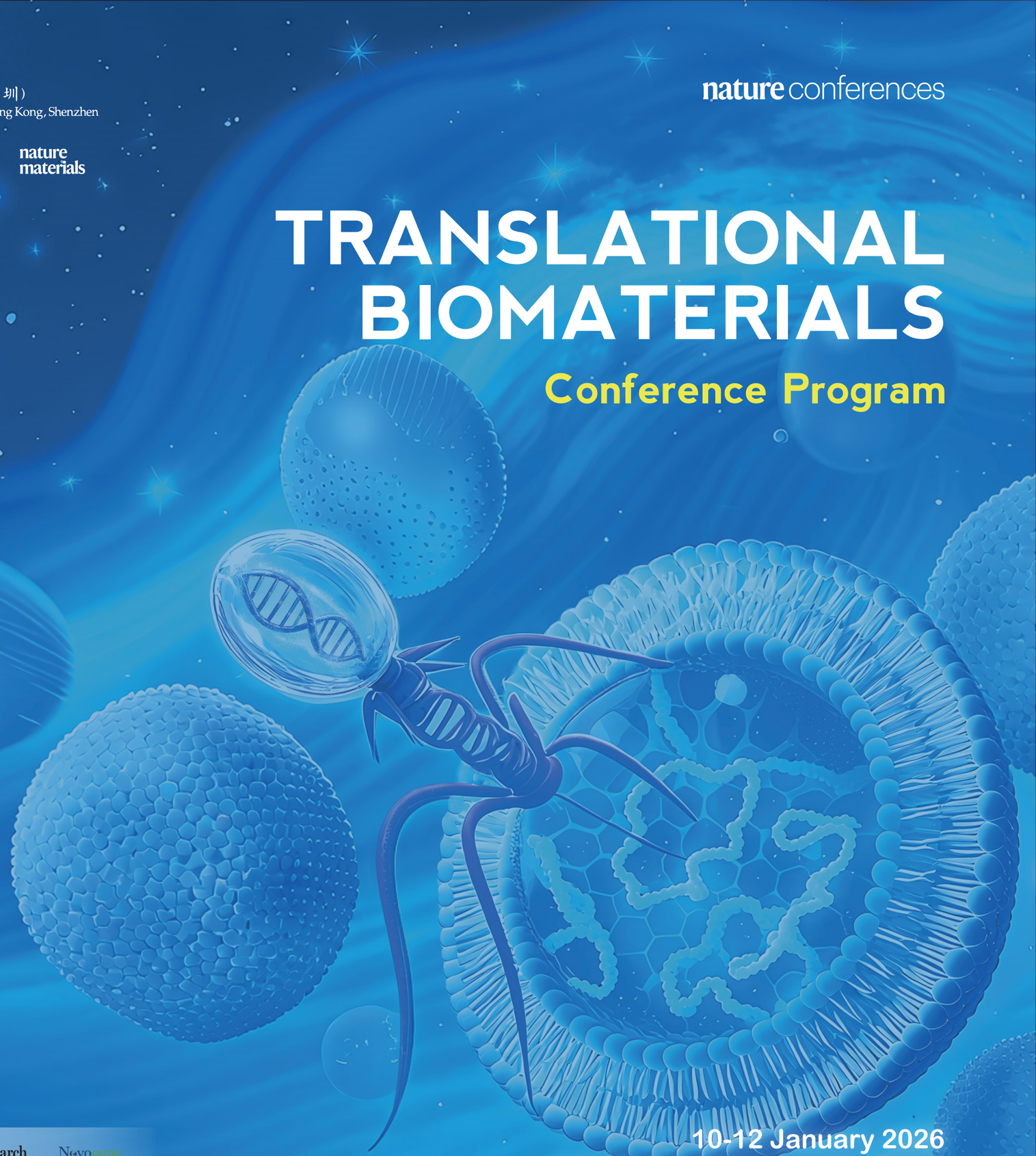
The Chinese University of Hong Kong
The Department of Biomedical Engineering at The Chinese University of Hong Kong
The Chinese University of Hong Kong, Shenzhen
Nature Biomedical Engineering
Nature
Nature Nanotechnology
Nature Materials

nature conferences

TRANSLATIONAL BIOMATERIALS

Conference Program



Special Thanks

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10-12 January 2026
CUHK, Hong Kong SAR, China

Conference Theme

Translational Biomaterials

Conference Purpose

The Nature conference on “Translational Biomaterials” will bring together leading international scientists to explore the application of biomaterials in drug delivery and personalised therapy, tissue engineering and repair, as well as diagnostics and sensing. The scientific talks–over three days–will be relevant to researchers focused on a range of therapeutic areas and target organs. Designed to foster dialogue between researchers with both fundamental and applied areas of expertise, this conference aims to address the gap between biomaterials research and the translation of these materials into clinical use.

Speakers

Chunying Chen
National Center for Nanoscience and Technology, China

Karen L. Christman
University of California San Diego, USA

Dennis Discher
University of Pennsylvania, USA

Jose Antonio Garrido
Catalan Institute of Nanoscience and Nanotechnology, Spain

Gabriel A. Kwong
Georgia Tech and Emory School of Medicine, USA

Twan Lammers
RWTH Aachen University Clinic, Germany

Kam Leong
Columbia University, USA

Riccardo Levato
University Medical Center Utrecht, The Netherlands

Shulamit Levenberg
Technion - Israel Institute of Technology, Israel

Roy van der Meel
Eindhoven University of Technology, The Netherlands

Suzie Pun
University of Washington, USA

Kanyi Pu
Nanyang Technological University, Singapore

Francesca Santoro
RWTH Aachen and Forschungszentrum Juelich, Germany

Huilin Shao
National University of Singapore, Singapore

Molly Shoichet
University of Toronto, Canada

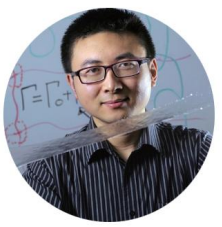
Ben Zhong Tang
The Chinese University of Hong Kong, Shenzhen, China

Li Tang
EPFL, Switzerland

Sihong Wang
The University of Chicago, USA

Joy Wolfram
The University of Queensland, Australia

Xiyun Yan
Institute of Biophysics, Chinese Academy of Sciences (IBP), China



Xuanhe Zhao
Massachusetts Institute of Technology, USA

Yuliang Zhao
National Center for Nanosciences and Technology of China, CAS, China

Scientific Committee

Chuanbin Mao
Chinese University of Hong Kong

Jennifer Haskell
Nature Biomedical Engineering

Ali Stoddart
Nature Materials

Chiara Pastore
Nature Nanotechnology

Bruno Castro
Nature Materials

Liqian Wang
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Conference Organizers

The Chinese University of Hong Kong (CUHK) is a world-class research university consistently ranked among the top 50 institutions globally (QS World University Rankings 2024). Renowned for its academic excellence and innovative research, CUHK blends Eastern and Western educational traditions.

The Department of Biomedical Engineering (BME) at The Chinese University of Hong Kong (CUHK) is a world-leading interdisciplinary hub dedicated to advancing healthcare through innovative engineering solutions. Ranked 11th globally in the 2024 Academic Ranking of World Universities (ARWU).

The Chinese University of Hong Kong, Shenzhen (CUHK-Shenzhen) is a Ministry of Education-approved institution that pioneers a unique model of higher education, bridging China and the world. Committed to excellence, it integrates Eastern and Western academic traditions while fostering innovation and research.

Nature Biomedical Engineering is an online-only monthly journal publishing original research, reviews and commentary of high significance to the biomedical engineering community, including bench scientists interested in devising materials, methods, technologies or therapies to understand or combat disease.

Nature is a weekly, international journal, publishing papers from any area of science with great potential impact and whose importance extends well beyond the confines of the specific discipline concerned. *Nature* has the highest impact factor of any journal publishing basic scientific research.

Nature Nanotechnology is an interdisciplinary journal that publishes papers of the highest quality and significance in all areas of nanoscience and nanotechnology. The journal covers research into the design, characterization and production of structures, devices and systems.

Nature Materials is a prestigious, peer-reviewed journal that focuses on the field of materials science. Established in 2002, it publishes cutting-edge research covering a broad spectrum of topics, including the synthesis, characterisation, and application of novel materials.

Conference Location

Conference Venue

Cheng Yu Tung Building, CUHK

12 Chak Cheung Street, Sha Tin, New Territories

Hong Kong

Route

Take the East Rail Line to University Station,

Exit from Exit B and turn right,

Then walk straight for 100 m.

If you start from the Hyatt Hotel, it's a 50-meter walk to get there.

Welcome Banquet

Venue: Club One Riviera, 55 Tai Chung Kiu Road, Sha Tin

Eligibility: Only participants with Attendant or VIP badges are eligible to join the Welcome Banquet.

Time: 7:00–9:30 p.m., January 9, 2026

Routes:

1) Shuttle bus: Wait at the entrance of the CYT Building (6:00-6:30 p.m.)

2) Taxi: Direct to Club One Riviera

3) MTR: Take the Tuen Ma Line to Shek Mun Station

Conference Program

9 January 2026

2:00 - 6:00 p.m.	Conference Registration Location: Lobby, Floor 1, Cheng Yu Tung Building, CUHK
7:00 - 9:30 p.m.	Welcome Banquet Location: Club One Riviera

10 January 2026

Chair: Ali Stoddart

Welcome Remarks

9:00 - 9:05 a.m.	Chuanbin Mao	Organizer, CUHK
9:05 - 9:10 a.m.	Dennis Lo Yuk-ming	President, CUHK
9:10 - 9:15 a.m.	Jennifer Haskell	*Nature Biomedical Engineering*

SESSION I: Drug Delivery I

Chair: Ali Stoddart

Keynote Talk

9:15 - 9:55 a.m.

Kam Leong
Columbia University, USA
Title: Reimagining Cationic Biomaterials for Therapeutic Applications

Invited Talk

9:55 - 10:25 a.m.

Li Tang
EPFL, Switzerland
Title: Multidimensional immunoengineering approaches to enhance cancer immunotherapy

10:25 - 10:55 a.m. Tea Break

Keynote Talk

10:55 - 11:35 a.m.

Yuliang Zhao
National Center for Nanosciences and Technology of China, CAS, China
Title: Particulate Chemical Biology in Drug Delivery: Partichemobiology

Invited Talk

11:35 - 12:05 p.m.

Joy Wolfram
The University of Queensland, Australia
Title: Extracellular vesicles as next-generation medicines

12:05 - 2:00 p.m. Lunch Break

SESSION II: Tissue Engineering

Chair: Jennifer Haskell

2:00 - 2:40 p.m.

Keynote Talk

Dennis Discher University of Pennsylvania, USA

Title: Convergent Science for Solid Tumors: From Polymersomes & Filomicelles to Macrophage Checkpoint Disruption & Cancer Immunity

2:40 - 3:10 p.m.

Invited Talk

Karen L. Christman University of California San Diego, USA

Title: Translation of Injectable Biomaterials for Regenerative Engineering

3:10 - 3:25 p.m.

Short Talk

Dongan Wang The Chinese University of Hong Kong

Title: Decellularized Tissue Engineering Hyaline Cartilage Graft for Articular Cartilage Repair and Its Forward-Looking Test for Space Medicine

3:25 - 3:40 p.m.

Short Talk

Dan Michelle Wang The Chinese University of Hong Kong

Title: Transcriptome-Guided Materiomics for the Rational Design of a Tenogenic Hydrogel Niche

3:40 - 4:10 p.m. Tea Break

4:10 - 4:40 p.m.

Meet the Editors

Editors from *Nature Biomedical Engineering*, *Nature*, *Nature Nanotechnology* and *Nature Materials*

Chair: Ali Stoddart

4:40 - 4:55 p.m.

Short Talk

Xing-Jie Liang National Centre for Nanoscience and Technology, China

Title: Functional Nanoparticles Adapted with biomedical effects for controllable delivery in vivo

4:55 - 5:10 p.m.

Short Talk

Guosong Chen Fudan University

Title: Materials for tissue engineering based on controlled network topology

5:10 - 5:25 p.m.

Short Talk

Xiaodong Zhang Tianjin University

Title: Atomically Precise Metal Clusters Enable High-Fidelity Clinical Neural Recording and Early Seizure Detection: the first-in-human study

5:25 - 6:30 p.m.

Poster Session

11 January 2026

SESSION III: Bioelectronics/Biosensing

Chair: Liqian Wang

9:00 - 9:40 a.m.

Keynote Talk

Xuanhe Zhao
Massachusetts Institute of Technology, USA
Title: Merging Humans and Machines: Innovation and Translation

9:40 - 10:10 a.m.

Invited Talk

Francesca Santoro
RWTH Aachen and Forschungszentrum Juelich, Germany
Title: Neuromorphic Biomaterials

10:10 - 10:40 a.m. Tea Break

10:40 - 11:10 a.m.

Invited Talk

Sihong Wang
The University of Chicago, USA
Title: Bioelectronic Materials for Tissue-Interfaced Continuous Biosensing

11:10 - 11:50 a.m.

Keynote Talk

Jose Antonio Garrido
Catalan Institute of Nanoscience and Nanotechnology, Spain
Title: Graphene thin film technology for neural interfaces

11:50 - 2:00 p.m. Lunch Break

SESSION IV: Diagnostics

Chair: Bruno Castro

2:00 - 2:40 p.m.

Keynote Talk

Kanyi Pu

Nanyang Technological University, Singapore

Title: Next-generation Optical Imaging Probes for Early Diagnosis and Precision Therapy

2:40 - 3:20 p.m.

Keynote Talk

Ben Zhong Tang

The Chinese University of Hong Kong, Shenzhen, China

Title: Conceptually New AIEgen-based Theranostic Systems

3:20 - 3:50 p.m.

Invited Talk

Huilin Shao

National University of Singapore, Singapore

Title: Integrated nanosensor technologies for molecular analyses of circulating biomarkers

3:50 - 4:20 p.m Tea Break

4:20 - 5:00 p.m.

Keynote Talk

Twan Lammers

RWTH Aachen University Clinic, Germany

Title: Diagnostic Tools and Technologies to Improve Cancer Nanomedicine Performance and Clinical Translation

5:00 - 5:30 p.m.

Invited Talk

Gabriel A. Kwong

Georgia Tech and Emory School of Medicine, USA

Title: Designing Synthetic Biomarkers for Earlier Cancer Detection

12 January 2026

SESSION V: Drug Delivery II

Chair: Chiara Pastore

9:00 - 9:40 a.m.

Keynote Talk

Chunying Chen

National Center for Nanoscience and Technology, China

Title: Active Manipulation Of The Nano–Protein Corona For Nanomedicine

9:40 - 10:10 a.m.

Invited Talk

Roy van der Meel

Eindhoven University of Technology, The Netherlands

Title: Apolipoprotein nanoparticle platform technology for RNA delivery to immune cells

10:10 - 10:40 a.m Tea Break

10:40 - 11:20 a.m.

Keynote Talk

Xiyun Yan

Institute of Biophysics, Chinese Academy of Sciences (IBP), China

Title: Nanozyme, a new biological catalyst and its applications

11:20 - 11:50 a.m

Invited Talk

Suzie Pun

University of Washington, USA

Title: Biomaterial strategies for cancer immunotherapy

Chair: Jennifer Haskell

11:50 - 12:05 p.m.

Short Talk

Liming Bian South China University of Technology

Title: Cell-adaptable dynamic hydrogels for biomedical applications

12:05 - 12:20 p.m.

Short Talk

Hon Fai Chai The Chinese University of Hong Kong

Title: A Triple-Layer Microfluidic Microphysiological System to Model USH-2A-Associated Retinal Diseases and Identify Novel Therapeutic Targets

12:20 - 12:35 p.m.

Short Talk

Heemin Kang Korea University

Title: Remotely Controllable Biomolecular Self-Assembly for Cancer and Regenerative Therapy

12:35 - 2:00 p.m. Lunch Break

2:00 - 2:40 p.m. **Poster Session**

SESSION VI: Tissue Engineering II

Chair: Chuanbin Mao

2:40 - 3:20 p.m.

Keynote Talk

Shulamit Levenberg
Technion - Israel Institute of Technology, Israel
Title: 4D Bioprinting of Engineered Vascularized Tissues

3:20 - 3:50 p.m.

Invited Talk

Riccardo Levato
University Medical Center Utrecht, The Netherlands
Title: Light-based and imaging-driven bioprinting: shining a new light on engineered tissues and organoids

3:50 - 4:20 p.m. Tea Break

4:20 - 5:00 p.m.

Keynote Talk

Molly Shoichet
University of Toronto, Canada
Title: Envisioning the future: from what if to clinical trials

5:00 - 5:15 p.m. **Poster Presentation Awards & Closing Remarks**

Program Details

You can access program details through the following:

ACCESS 1: Nature Conferences Website

——The Full conference Book (with speaker introductions and lecture abstracts)

——Poster Information (including displays and abstracts)

ACCESS 2: WeChat Official Account of the Phage Academic Alliance

——The Full conference Book (with speaker introductions and lecture abstracts)

——Poster Information (including displays and abstracts)

——Conference News

ACCESS 3: Alltuu Photo Live Coverage

——Live Photo Sharing

Abstract of Lecture

Chunying Chen

National Center for Nanoscience and

Technology, China

Prof. Chunying Chen, Academician of Chinese Academy of Sciences and TWAS Member, New Cornerstone Investigator, Professor in National Center for Nanoscience and Technology, and Director of Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences.

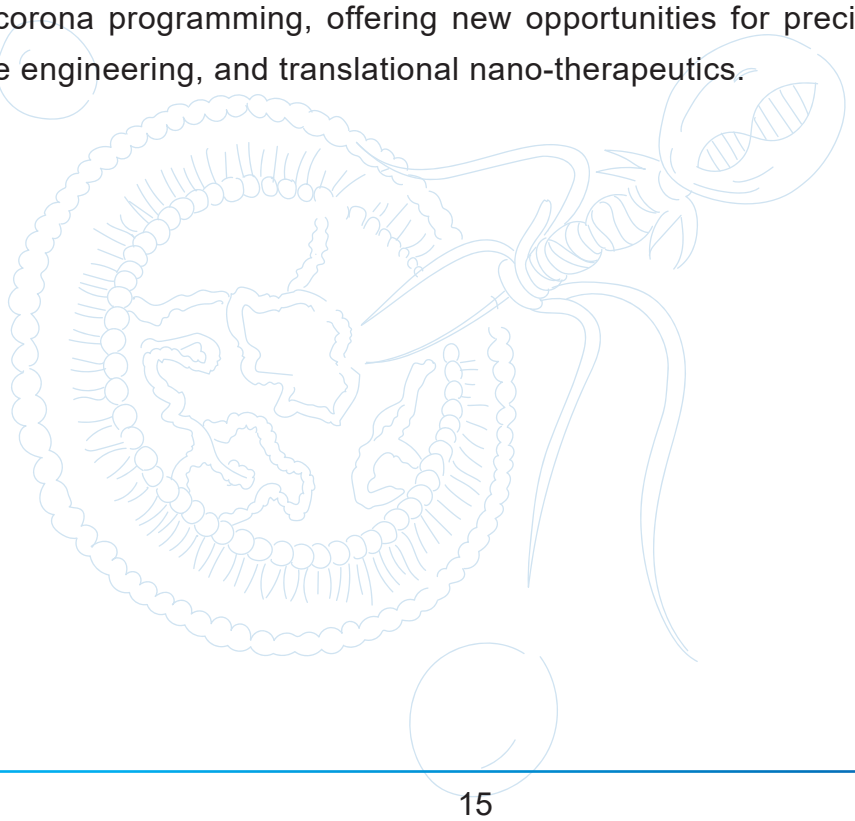
She has long been dedicated to research in analytical chemistry and the chemico-biological effects of nanomaterials in biological systems. Her research focuses on critical challenges regarding structural properties, chemico-biological behaviors, and nano-bio interfacial interactions of medical nanomaterials. Her systematic investigations have led to applications in vaccine adjuvants and drug delivery systems, thereby providing fundamental support for nanobiomedical applications. She has published over 400 peer-reviewed articles including Nature Nanotechnology, Nature Methods, Nature Protocols, Nature Communications, Science Advances, PNAS, JACS and Angew Chem. She has received numerous awards, including the Second Prize of the National Natural Science Award, IUPAC Distinguished Women in Chemistry or Chemical Engineering, TWAS Chemistry Award, RSC Environment Prize, ACS Bioconjugate Chemistry Lectureship award, Chinese Young Female Scientists Award. She is currently an Executive Editor of ACS Nano and editorial board members of several journals. She is Vice President of Chinese Society of Toxicology and the Biophysical Society of China.

Active Manipulation Of The Nano–Protein Corona For Nano-medicine

The protein corona formed on nanoparticles in biological environments dictates their biological identity, cellular recognition, and in vivo fate. However, conventional nanomaterial design largely relies on passive corona formation, resulting in unpredictable interactions and limited translational potential. Here we present a strategy for active manipulation of the nano–protein corona through rational surface chemistry engineering to recruit defined endogenous proteins in situ. We show that precise tuning of stereochemistry, lipid structure, hydrophobic domain distribution, enables selective enrichment of opsonins, dysopsonins, complement regulators, and immune-relevant proteins. These programmed corona profiles drive predictable cellular uptake pathways, control organ tropism, and significantly improve the efficiency of vaccine delivery and gene-modulation nanotherapeutics.

We further demonstrate that corona-directed targeting allows (i) enhanced splenic dendritic cell recruitment for long-acting antigen presentation, (ii) improved follicular trafficking for subunit vaccine boosting.

Altogether, this work provides a generalizable paradigm for engineering nanomaterials via active protein corona programming, offering new opportunities for precision nanomedicine design, immune engineering, and translational nano-therapeutics.



Karen L. Christman

University of California San Diego, USA

Dr. Christman is a Professor in the Shu Chien-Gene Lay Department of Bioengineering, the Associate Dean for Faculty Affairs and Welfare, and holds the Pierre Galletti Endowed Chair for Bioengineering Innovation in the Jacobs School of Engineering at UC San Diego. She received her B.S. in Biomedical Engineering from Northwestern University in 2000 and her Ph.D. from the University of California San Francisco and Berkeley Joint Bioengineering Graduate Group in 2003, where she examined *in situ* approaches to myocardial tissue engineering. She was also a NIH postdoctoral fellow at the University of California, Los Angeles in the fields of polymer chemistry and nanotechnology. Dr. Christman joined the Department of Bioengineering in 2007 and is Co-Director of the Sanford Advanced Therapy Center in the Sanford Stem Cell Institute at the UC San Diego. Her lab, which is housed in the Sanford Consortium for Regenerative Medicine, focuses on developing novel biomaterials for tissue engineering and regenerative medicine applications, and has a strong translational focus with the main goal of developing minimally invasive therapies for cardiovascular disease and women's health. Dr. Christman is a fellow of the American Heart Association, the American Institute for Medical and Biological Engineering, the Biomedical Engineering Society, the Tissue Engineering and Regenerative Medicine International Society and the American Association for the Advancement of Science, and has received several awards including the NIH Director's New Innovator and Transformative Research Awards, the Wallace H. Coulter Foundation Early Career Translational Research Award, the Tissue Engineering and Regenerative Medicine International Society's Young Investigator and Senior Scientist Awards, the Society for Biomaterials Clemson Award for Applied Research, and the AIMBE Professional Impact Award. Dr. Christman is also a Senior Member of the National Academy of Inventors and a co-founder of Ventrix, Inc. and Karios Technologies, Inc.

Translation of Injectable Biomaterials for Regenerative Engineering

We have developed a variety of injectable extracellular matrix (ECM) derived biomaterials that form scaffolds once injected in vivo, as well as a new infusible ECM for intravascular delivery. These ECM biomaterials are showing promise for regenerative engineering in several applications including cardiovascular disease and women's health. This talk will cover our translational pathway and progress with these materials including the first clinical trial in myocardial infarction patients.

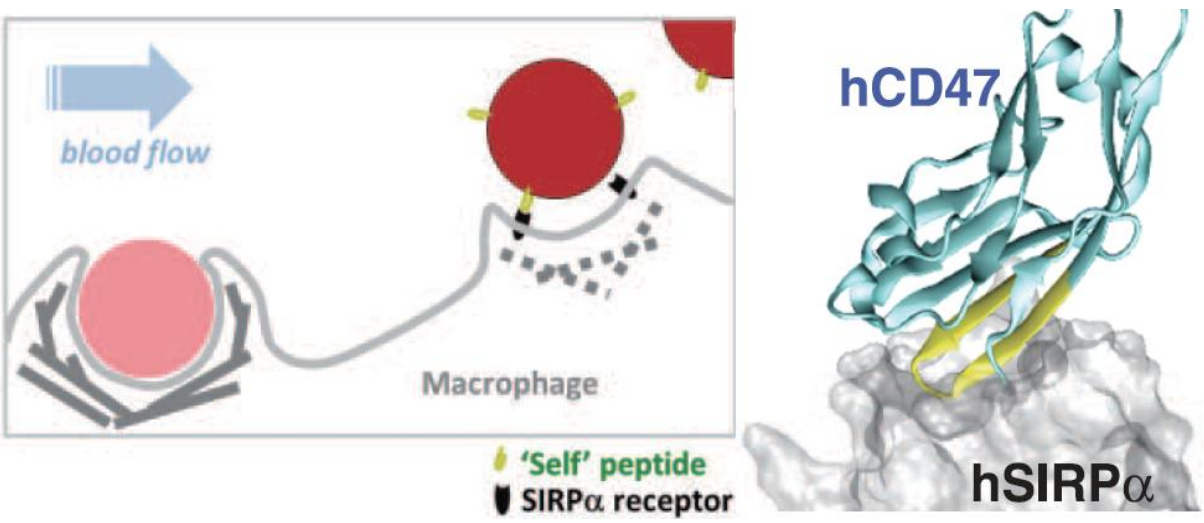
Dennis Discher

University of Pennsylvania, USA

Discher earned his Ph.D. from the University of California, Berkeley and San Francisco in 1993, and has been at the University of Pennsylvania since 1996. He has been elected to the US National Academy of Engineering, the US National Academy of Medicine, and the American Academy of Arts & Sciences, and is also an elected Fellow of the American Society for Cell Biology, and the American Association for the Advancement of Science. His lab's discoveries range from self-assembling block copolymers (polymersomes, filomicelles) and immune recognition of 'Self' (with disease/cancer applications) to the polymer-physics and mechanobiology of stem cell differentiation, nuclei, and solid tumor evolution. Among the >250 publications with >90,000 citations from his lab, various papers have appeared in *Science*, *Cell*, *PNAS*, and various *Nature* journals. Discher serves on Editorial Boards of *Science*, *Molecular Biology of the Cell*, and *PNAS Nexus* among other journals.

Convergent Science for Solid Tumors: From Polymersomes & Filomicelles to Macrophage Checkpoint Disruption & Cancer Immunity

From viruses to tissue matrices, biology is filled with remarkable polymeric structures that have long motivated mimicry with goals of at least clarifying and perhaps exploiting biological principles. Viruses including filamentous-viruses inspired our development and computations of block copolymer polymersomes and 'filomicelles' that persist in the circulation, load anti-cancer drugs, and suppress tumor growth. However, particles of any type are cleared by macrophages while nearby 'Self' cells are spared due to a polypeptide that limits phagocytic clearance. This led to a materials-inspired cell therapy with engineered macrophages that not only eliminate tumors but vaccinate mice against recurrent challenge. Parallel studies with hydrogels led to the discovery of matrix elasticity effects on differentiation, which is informing our ongoing studies of macrophage polarization.



Legend: In the context of blood flow, a Self peptide and hCD47 prolong the circulation of particles by binding the SIRPa receptor on the macrophage and inhibiting uptake by the spleen.

Jose Antonio Garrido

Catalan Institute of Nanoscience and

Nanotechnology, Spain

Jose A. Garrido is an ICREA Research Professor at the Catalan Institute of Nanoscience and Nanotechnology (ICN2) in Barcelona, where he leads the Advanced Electronic Materials and Devices group. He received his Master's and PhD degrees in Telecommunication Engineering from the Polytechnic University of Madrid, and a habilitation degree from the Technical University of Munich. Since 2017 he has served as ICN2's Vice-director, contributing to its scientific and innovation strategy. His research focuses on the science and technology of 2D materials and their application in bioelectronics and neural interfaces. He leads major national and European research initiatives aimed at developing novel neural interfaces for biomedical applications. He is also co-founder and Chief Scientific Officer of INBRAIN Neuroelectronics, an ICN2 spin-off company developing graphene-based neural devices for medical applications.

Graphene thin film technology for neural interfaces

Establishing a reliable bidirectional communication interface between the nervous system and electronic devices is critical for exploiting the full potential of neurotechnology. Despite recent advancements, current technologies evidence important shortcomings, e.g. lack of focal stimulation, low signal-to-noise ratio, etc. Thus, efforts to explore novel materials are essential for the development of next-generation neural interfaces. Graphene and graphene-based materials possess a very attractive set of physicochemical properties holding great potential for implantable neural interfaces.

This presentation provides an overview on the technology and applications of graphene-based thin film devices for neural stimulation and recording. It covers device architectures, microfabrication, and surface engineering for improved charge injection and noise reduction. Furthermore, this contribution summarizes in vivo performance, including spatial selectivity, chronic stability, in rodent and large-animal models. Finally, the talk will address recent efforts toward clinical translation of this technology, including topics like scalable manufacturing, safety, and regulatory testing.

Acknowledgements

This work has been partially funded by the EU Horizon Europe programme under Grant Agreement no. 101070865 (MINIGRAPH) and no. 101136541 (GphT-BCI).

Gabriel A. Kwong

Georgia Tech and Emory School of Medicine, USA

Gabe Kwong is the Robert A. Milton Endowed Chair & Professor of Biomedical Engineering at Georgia Tech and Emory School of Medicine. His research program sits at the intersection of synthetic immunity and medicine, with a particular emphasis on developing biosensors and cell therapies for cancer. A native of the San Francisco Bay Area, Dr. Kwong received his B.S. from UC Berkeley, Ph.D. from Caltech, and completed postdoctoral studies at MIT. He has been recognized with selective distinctions, including the NIH Director's New Innovator and Pioneer Awards, and currently leads the $49.5 million Cancer and Organ Degradome Atlas (CODA) project – a multi-institutional initiative supported by ARPA-H that aims to transform early cancer detection. Dr. Kwong co-founded 3 biotech companies and holds 40+ issued or pending patents.

Designing Synthetic Biomarkers for Earlier Cancer Detection

Detecting cancer at an early stage has the potential to reduce cancer-related deaths and improve the likelihood of curative treatment. However, native tumor-shed biomarkers are found at vanishingly small quantities in biofluids that they offer limited potential to set early-stage tumors apart from healthy tissue. Over the past decade, our work has charted a new path forward based on querying tissues, instead of a biological sample, for earlier cancer detection. Our approach deploys bioengineered sensors inside the body to hunt for malignant cells and then use their ubiquitous dysregulation of protease activity to drive the release of a synthetic biomarker to levels that can far exceed those achievable by a native tumor biomarker. In this presentation, I will present our work on displaying protease-activatable receptors on T cells to create a measurement tool for mapping the cancer degradome across various cancer types and tissues. I will highlight how this activity-based atlas can be harnessed for the design of ultrasensitive protease biosensors with improved detection limits compared to conventional blood biomarkers and execute Boolean logic to improve specificity. Our work illustrates how synthetic biology and bioengineering can drive the development of improved tools for cancer profiling and detection.

Twan Lammers

RWTH Aachen University Clinic, Germany

Twan Lammers obtained a D.Sc. in Radiation Oncology from Heidelberg University in 2008 and a Ph.D. in Pharmaceutical Technology from Utrecht University in 2009. In the same year, he started the Nanomedicine and Theranostics group at the RWTH Aachen University and the Helmholtz Institute for Biomedical Engineering. In 2014, he was promoted to full professor of medicine at RWTH Aachen University Clinic. His group aims to individualize and improve disease treatment by combining drug targeting with imaging. To this end, image-guided (theranostic) drug delivery systems are being developed, as well as materials and methods to monitor tumor growth, angiogenesis, inflammation, fibrosis and metastasis. Lammers has received multiple scholarships and awards, including ERC starting, consolidator and proof-of-concept grants, the CRS Young Investigator Award, the Adritelf International Award, the Belgian Society for Pharmaceutical Sciences International Award, the JNB Trailblazer Award, and the CRS Exceptional Leadership Award. He has been on the board of directors of CRS for 7 years and served as president in 2023-2024. In addition, has been on the council of ESMI for 10 years and currently serves as secretary. Lammers has published over 300 papers, with over 35000 citations and an h-index of 96. He is a member of the editorial board of 10 journals, and acts as associate editor for JCR, DDTR and MIB. Since 2019, he has been included in the Clarivate Analytics list of Highly Cited Researchers.

Diagnostic Tools and Technologies to Improve Cancer Nanomedicine Performance and Clinical Translation

Nanomedicines are extensively used for cancer therapy. The tumor accumulation of nanomedicines is notoriously heterogeneous, both in animal models and in patients. To address tumor targeting heterogeneity, and to advance cancer nanomedicine clinical translation, we are using diagnostic tools and technologies to monitor, predict and modulate tumor-targeted drug delivery. In the present lecture, several of these strategies will be highlighted, including ultrasound-based methods to prime the tumor microenvironment, and the use of imaging and tissue biomarkers for patient stratification. Altogether, our work aims to establish rational and realistic ways forward to improve the performance and clinical impact of cancer nanomedicines.

Kam Leong

Columbia University, USA

Dr Leong is the Samuel Y. Sheng Professor of Biomedical Engineering at Columbia University. He is one of the pioneers in developing multifunctional nanocarriers for delivery of drugs, antigens, proteins, siRNA, pDNA, and mRNA. Dr. Leong's contributions have been recognized by his election to the USA National Academy of Engineering, National Academy of Medicine, National Academy of Inventors, and the Asian American Academy of Science and Engineering. Recent awards include the Society for Biomaterials' Founders Award (2022), the IEEE-EMBS Career Achievement Award (2023), and the IEEE Biomedical Engineering Award (2024). Dr. Leong has been serving as the Editor-in-Chief of *Biomaterials* for the past decade.

Reimagining Cationic Biomaterials for Therapeutic Applications

Nonviral gene delivery has traditionally relied on cationic biomaterials to deliver nucleic acids for exogenous gene transfer. In contrast, our work explores the unconventional use of cationic biomaterials to remove nucleic acid-associated pathogenic signals, such as PAMPs and DAMPs, for anti-inflammatory therapy. Unexpectedly, we have also found that these cationic nanomaterials possess unique properties that modulate molecular signaling pathways and elicit pro-regenerative tissue responses. This presentation will highlight the mechanistic evidence and implications of this emerging direction in biomaterials research.

Riccardo Levato

University Medical Center Utrecht, The Netherlands

Riccardo Levato is Associate Professor at Utrecht University and at the University Medical Center Utrecht (The Netherlands), where he is principal investigator at the Living Matter Engineering and Biofabrication laboratory. His research focuses on developing lab-made tissues and designer organoids for personalized therapies and regenerative medicine, and as advanced in vitro models for drug discovery. To achieve this goal, with his team he develops novel additive manufacturing and bioprinting technologies, particularly light-based printing techniques, in combination with smart cell-instructive biomaterials, and synthetic biology and cell engineering strategies. Key applications include pancreas bioprinting for diabetes research, liver biofabrication and vascular tissue engineering. He pioneered volumetric bioprinting, a technique capable to pattern cells and material into centimeter-scale constructs within seconds. To date, he co-authored >90 papers and several patents in the fields of biomaterials and additive manufacturing, and supervised 22 PhD students and 6 postdocs. He is a European Research Council laureate, and received several awards, including the Mid Career award from the International Society for Biofabrication, the Jean Leray and Robert Brown awards from the European Society for Biomaterials and from the Tissue Engineering an Regenerative Medicine International Society. Riccardo is also member of the Young Academy of Europe, and he serves on the Board of Directors of the International Society for Biofabrication.

Light-based and imaging-driven bioprinting: shining a new light on engineered tissues and organoids

In the quest to capture the complex environment of living organs within lab-made tissues, light emerged as a uniquely powerful stimulus for enabling dynamic and spatio-temporal control over cell and biomaterial properties, opening new avenues in regenerative medicine and tissue engineering. Light-responsive moieties permit to non-invasively trigger mechanical actuation and shape-changes in cell-laden constructs, to modulate stiffening or softening of the extracellular milieu, and to enable spatio-temporal control over cell behavior. Previously, we introduced volumetric bioprinting (VBP), an ultra-fast, layer-less visible light-based biofabrication approach, to resolve virtually any 3D geometrical patterns in less than 20 seconds by projecting tomographic patterns onto photosensitive hydrogels making it possible to sculpt cell-laden materials with unprecedented geometrical freedom into high resolution architectures. Using visible light volumetric bioprinting technologies and protein-derived photoresponsive hydrogels, complex mini-organ models, also termed organoids, can be safely assembled into centimeter scale living tissues in a matter of few seconds. Herein, the most recent advances in light-driven biofabrication will be presented, together with our efforts to engineer functional blood vessels, breast gland tissue, and pancreatic tissues as advanced biological models, using organoids as living building blocks. Challenges in recreating vascularized environments can be addressed converging light-based volumetric printing with microgel-based printable materials, as well as via combining VBP other fabrication techniques, such as extrusion-based bioprinting and melt electrowriting. Moreover, spatial-specific functionalization with growth factors and biochemical signals can be achieved via a secondary VBP process to graft bioactive proteins in specific locations. Further advancing this technology, precise imaging strategies are leveraged to for enhanced metrology, quality control, and for introducing the concept of context-aware printing. In context-aware manufacturing, making printers that are able to detect objects, cells and features of interest within the printing vat, enables the creation of constructs that match the metabolic demands of the embedded cells, facilitates multi-material printing and overprinting, and permits to print across opaque, light-occluding elements, allowing for the creation of complex composite materials and living tissues. Overall, introducing anisotropic, multicellular/multimaterial patterns within volumetrically bioprinted constructs enables the biofabrication of freeform tissue models that more closely mimic the complex biochemical and structural composition of native tissues, to more precisely guide cell fate and maturation.

Shulamit Levenberg

Technion - Israel Institute of Technology, Israel

Shulamit Levenberg, PhD, is a professor at the Faculty of Biomedical Engineering at the Technion and director of the Technion's 3D Bioprinting Center. Prof Levenberg conducts interdisciplinary research on tissue regeneration and engineering 3D tissue models. She received numerous awards including the prestigious Krill, Rappaport and Bruno prizes for excellence in scientific research and the Medal of Distinction from the Peres Center for Peace and Innovation. Prof. Levenberg is a member of the American Institute for Medical and Biological Engineering and a fellow of the National Academy of Inventors. She is the former President of the Israel Stem Cell Society and the former Dean of the Technion Faculty of Biomedical Engineering. Prof Levenberg is a co-founder and chief scientific advisor of three start-up companies in the areas of cultured meat, modified exosomes for spinal cord regeneration and nanoliter arrays for rapid antimicrobial susceptibility testing. She received her B. Sc in Biology from the Hebrew University in Jerusalem, Ph.D. in Molecular cell biology from the Weizmann Institute and did her Post doc research on Tissue Engineering with Prof Langer at MIT.

4D Bioprinting of Engineered Vascularized Tissues

4D bioprinting introduces a transformative dimension to tissue engineering by integrating time as a critical factor in bioprinted constructs. It leverages dynamic materials and stimuli-responsive strategies to create constructs capable of morphing, growing, or adapting post-fabrication. This paradigm shift opens new horizons for engineering functional vascularized tissues that respond to environmental changes, enabling enhanced integration, repair, and functionality in vivo.

Fabricating living tissues is inherently a dynamic process. Cells actively interact with biomaterials during both the fabrication and maturation phases, significantly influencing the shape, size, mechanical properties, and extracellular matrix (ECM) composition of the resulting tissue. While acellular 3D printing offers high fidelity, introducing cells often results in constructs that undergo substantial transformations during post-printing cultivation. These transformations can lead to tissues with morphologies and properties that differ greatly from the original design. In our studies we explored how 4D bioprinting can embrace and harness these dynamic processes for fabricating hierarchical vascular networks with high precision. With development of biomaterials and bioprinting strategies designed to anticipate and accommodate temporal changes, we can optimize final tissue outcomes. By leveraging the inherent dynamism of living systems, bioprinting offers the potential to create more functional and biologically relevant constructs.

Roy van der Meel

Eindhoven University of Technology, The Netherlands

Roy van der Meel is a biomedical engineer specialized in nanomedicine and RNA therapeutics. After obtaining a PhD from Utrecht University, he moved to Pieter Cullis' lab at the University of British Columbia where he gained extensive experience with lipid nanoparticle technology. In 2019, Roy was recruited to Eindhoven University of Technology by Willem Mulder, where he is currently appointed Associate Professor in the Precision Medicine group.

Roy's research is supported by a Dutch Research Council (NWO) Vidi Grant and focuses on engineering RNA-based nanomedicines to precisely regulate immune cell function, aiming to treat diseases like cancer and autoimmune disorders. He has co-authored over 60 publications in journals including Nature Nanotechnology, Nature Biomedical Engineering, Journal of Controlled Release, and ACS Nano, and he was awarded the Controlled Release Society Young Investigator Award in 2024.

Apolipoprotein nanoparticle platform technology for RNA delivery to immune cells

Nucleic acid therapeutics hold great promise for gene silencing, expression, or editing but require sophisticated nanotechnologies to achieve efficient delivery following systemic administration. Lipid nanoparticle (LNP) technology is currently the gold-standard delivery platform, enabling the clinical translation of the first siRNA drug and mRNA vaccines. However, approved LNP systems are largely optimized for vaccine applications via local administration or hepatic delivery following intravenous administration.

To enable therapeutic applications beyond the liver, we have recently developed a nanotechnology-based delivery platform derived from natural lipoproteins for targeted and intracellular RNA delivery to immune cells. By leveraging the inherent ability of the apolipoprotein nanoparticle (aNP) platform to engage immune cells, we achieve functional gene silencing or gene expression in specific immune cell subsets and their bone marrow progenitors, thereby creating new opportunities for immunotherapy development.

Suzie Pun

University of Washington, USA

Suzie H. Pun is the Washington Research Foundation Professor of Bioengineering, Director for the Molecular Engineering and Sciences Institute, and Associate Director of the Resuscitation Engineering Science Unit (RESCU) at University of Washington. She is a fellow of the U.S. National Academy of Inventors (NAI) and American Institute of Medical and Biological Engineering (AIMBE), and has been recognized with MIT Technology Review's "Top 100 Young Innovators" designation, the Presidential Early Career Award for Scientists and Engineers, and as an AAAS-Lemelson Invention Ambassador. She was also recognized with the University of Washington's Marsha Landolt Distinguished Graduate Mentor Award for her dedicated mentoring of students. She currently serves as an Associate Editor for ACS Biomaterials Science and Engineering and on the Science Board of Reviewing Editors.

Suzie Pun received her B.S. in Chemical Engineering from Stanford University and her Ph.D. in Chemical Engineering from the California Institute of Technology. She also worked as a senior scientist at Insert Therapeutics/Calando Pharmaceuticals developing polymeric drug delivery systems before joining the Department of Bioengineering at University of Washington. Her current work focuses on biomaterial applications in drug delivery, trauma medicine and cell therapy.

Biomaterial strategies for cancer immunotherapy

Nature has mastered complexity, adaptability, and precision—qualities we strive to emulate in biomimetic materials design. In this presentation, I will highlight three projects that integrate biomaterials and immunotherapy to improve cancer treatment outcomes. First, we developed aptamer-based reagents as high-affinity alternatives to antibodies for isolating cells during cell manufacturing. These synthetic nucleic acid ligands offer advantages in stability, cost, and scalability, addressing key bottlenecks in cell therapy production. Second, I will introduce IMPACT (In situ Mobilization: Polymer-Activated CAR T cells), a strategy to overcome limitations of CAR T cells in solid tumors. IMPACT employs a tumor-targeted polymer that works in concert with logic-gated CAR T cells to improve their specificity of action at tumor sites. Finally, I will discuss our VIPER (Virus-Inspired Polymers for Endosomal Release) platform, designed to mimic viral mechanisms for intracellular delivery of biologics. Building on this, we developed a cancer vaccine system incorporating VIPER and STING agonists to boost innate immune activation by targeted delivery to antigen presenting cells. Together, these projects illustrate how nature-inspired materials can be applied for cancer immunotherapy applications.

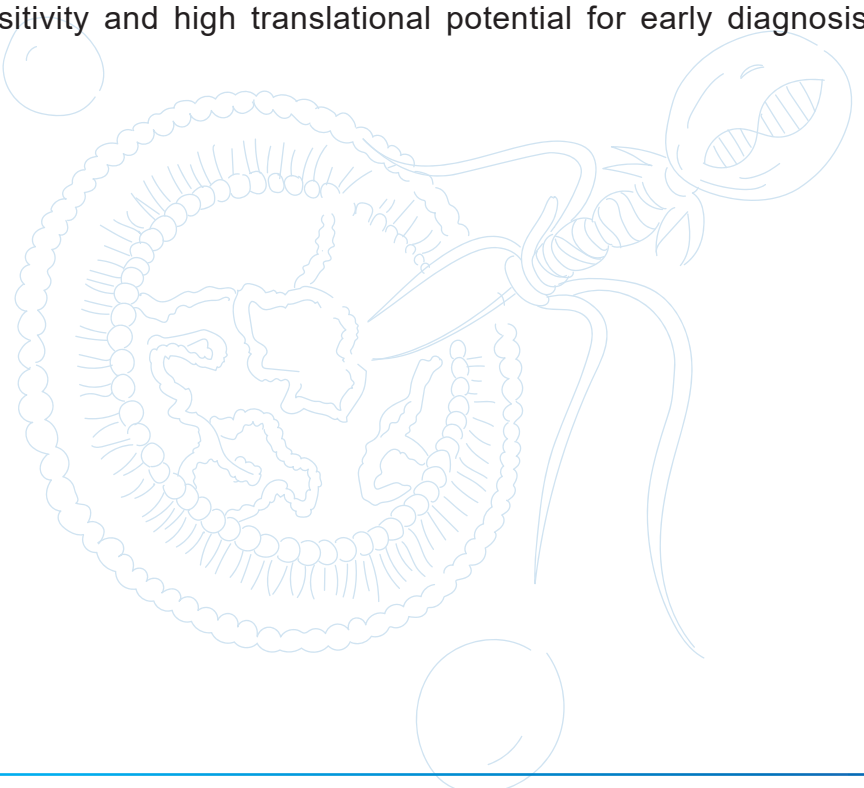
Kanyi Pu

Nanyang Technological University, Singapore

Prof. Kanyi Pu is a President's Chair Professor at the School of Chemistry, Chemical Engineering and Biotechnology (CCEB) and Lee Kong Chian School of Medicine at Nanyang Technological University (NTU). He also serves as Associate Dean for Research at the College of Engineering and is an Executive Editor of the Journal of the American Chemical Society. With a h-index of 125 and over 40,000 citations, he has been acknowledged as one of the world's most influential researchers by Web of Science, and received esteemed awards, including the Singapore National Research Foundation (NRF) Investigatorship and the Biomaterials Science Lectureship Award. He also acts as an editorial advisory board member for over 18 renowned journals, including Advanced Materials, Chemical Society Reviews, Advanced Functional Materials, Biomaterials, Small, and Bioconjugate Chemistry.

Next-generation Optical Imaging Probes for Early Diagnosis and Precision Therapy

Molecular optical imaging plays a crucial role in biology and medicine. However, the strong tissue autofluorescence and shallow tissue penetration of optical imaging compromise not only its sensitivity and specificity but also limit its clinical translation. In this talk, I will introduce our approaches (molecular afterglow imaging and artificial urinary biomarkers) to tackle these challenges. First, I will introduce molecular afterglow probes with long-lasting luminescence after cessation of electromagnetic irradiation by light, ultrasound, or X-ray. Due to the elimination of real-time light excitation, molecular afterglow probes have a signal-to-background ratio more than two orders of magnitude higher than NIR fluorescence, allowing for sensitive detection of tiny peritoneal metastatic tumors and monitoring therapeutic outcomes. Second, I will discuss how to design renal-clearable optical probes as artificial urinary biomarkers (AUBs) for the early diagnosis of acute kidney injury and allograft rejection as well as the profiling of tumor immune microenviroment. AUBs can specifically activate their optical signals toward the biomarkers of interest, followed by rapid renal clearance for urine tests. They can thus act as artificial urinary biomarkers to bypass the tissue penetration issue of optical imaging, permitting optical urinalysis that outperforms typical clinical/preclinical assays. These studies provide the basis for an entirely new class of molecular optical probes with ultrahigh sensitivity and high translational potential for early diagnosis and precision medicine.



Francesca Santoro

RWTH Aachen and Forschungszentrum Juelich,

Germany

Francesca Santoro, born in Naples in 1986, is a biomedical engineer specialed in neuroelectronics. She earned her Bachelor's and Master's degrees in Biomedical Engineering at the University of Naples Federico II, followed by a PhD from RWTH Aachen and Forschungszentrum Juelich in 2014. After a postdoctoral fellowship at Stanford University, she founded the Tissue Electronics Lab at the Istituto Italiano di Tecnologia. Currently, she is Full Professor and Head of the Neuroelectronic Interfaces Lab at RWTH Aachen and Forschungszentrum Juelich.

Her awards include the MIT Technology Review Under 35 Europe and Italy, an ERC Starting Grant, the Falling Walls Breakthrough Award, and early career recognition from the German National Academy of Sciences Leopoldina. She has published over 80 peer-reviewed articles and delivered more than 60 talks at major international conferences.

Neuromorphic Biomaterials

The convergence of bioelectronics and materials science is giving rise to neuromorphic biomaterials that emulate the dynamic processing of the human brain. At the core of this effort are bioinspired architectures that integrate functional electronics with 3D cellular environments, enabling seamless interaction with neural tissues.

One of the central innovations is the fabrication of 3D artificial dendritic spines and fibers, engineered using two-photon polymerization and organic conductive blends. These structures closely mimic the morphology of synaptic junctions, facilitating local synaptic plasticity and enabling targeted guidance of neuronal growth. Varied morphologies, thin contact-initiating protrusions, mushroom-like spines with reshaping capabilities, and stubby constructs, demonstrate mechanical compatibility and functional enhancement of synaptic signaling.

In parallel, conductive hydrogels have emerged as critical components in establishing soft, tissue-like interfaces. These hydrogels, functionalized with PEDOT:PSS or other ionic-electronic polymers, that can be micropatterned in neuron-like shapes and be integrated within electrochemical neuromorphic devices, these materials reproduce key synaptic behaviors, including neurotransmitter-induced long-term potentiation and short-term facilitation.

The coupling of these 3D bioelectronic platforms with opto-responsive materials, such as azopolymer-functionalized surfaces, introduces a layer of optical control over network activity and plasticity. Furthermore, supported lipid bilayers formed from neuronal blebs or artificial vesicles offer membrane-mimetic environments for modulating ion transport and enabling synapse-like behavior at the interface.

Together, these neuromorphic biomaterials represent a new paradigm in brain-machine interfacing, one where material morphology, chemistry, and functionality coalesce to support adaptive, biocompatible, and high-fidelity interactions with the nervous system.

Huilin Shao

National University of Singapore, Singapore

Dr. Huilin Shao is Dean's Chair Associate Professor, Department of Biomedical Engineering, and Principal Investigator, Institute for Health Innovation & Technology (iHealthtech), National University of Singapore. Dr. Shao received her BA from Cornell University, with a double major in Biological Sciences and in Physics. She completed her dual PhD (Biophysics) at Harvard University and PhD (Medical Engineering) from Harvard-MIT Health Sciences and Technology (HST). Her research focuses on developing integrated nanotechnology platforms for molecular analyses of novel biomarkers. She has pioneered multiple technologies to advance molecular diagnostics. Her work has been published in top journals such as Nature Biotechnology, Nature Nanotechnology, Nature Medicine, Nature Biomedical Engineering, Nature Communications and highlighted in major reviews and popular news media. In recognition of her achievement, Dr. Shao has received multiple awards, including James Mills Pierce Award, A*STAR Independent Fellowship, NUS Early Career Research Award, the L'Oreal For Women in Science National Fellowship, Springer-Nature MINE Young Scientist Award, and Singapore Presidential Young Scientist Award.

Integrated nanosensor technologies for molecular analyses of circulating biomarkers

The growing emphasis on personalized medicine significantly increases the need to analyze key molecular markers. In comparison to tissue biopsies, circulating biomarkers (liquid biopsies) can be conveniently and repeatedly obtained from biofluids with minimal complications. Extracellular vesicles have recently emerged as a promising circulating biomarker. Extracellular vesicles are nanometer-sized membrane vesicles actively shed off by cells and possess unique advantages: they abound in biofluids and harbor diverse molecular contents. In this talk, I will describe various nanosensor systems we have developed for quantitative analyses of diverse circulating biomarkers. These technologies integrate advances in device engineering, nanomaterial sciences and molecular biology. By enabling rapid, sensitive and cost-effective detection of circulating biomarkers, these platforms could significantly expand the reach of preclinical and clinical research, in informing therapy selection, rationally directing trials, and improving sequential monitoring to achieve better clinical outcomes.

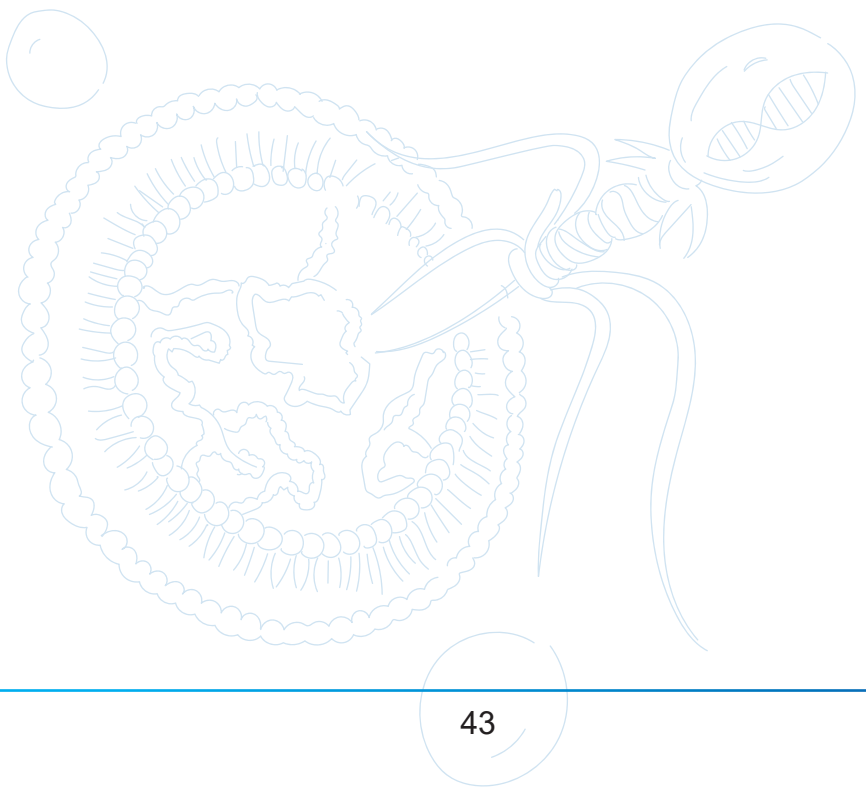
Molly Shoichet

University of Toronto, Canada

Professor Molly Shoichet is University Professor, a distinction held by less than 2% of the faculty. She is the inaugural Pamela & Paul Austin Chair in Precision and Regenerative Medicine, and Scientific Director of Precision Medicine (PRiME) and BioHubNet at the University of Toronto. Shoichet served as Ontario's first Chief Scientist in 2018 where she worked to enhance the culture of science. Dr. Shoichet has published over 850 papers, patents and abstracts and has given nearly 600 lectures worldwide. She currently leads a laboratory of 30 and has graduated 305 researchers. Her research is focused on drug and cell delivery strategies in the central nervous system (brain, spinal cord, retina), 3D hydrogel culture systems to model cancer and colloidal drug aggregates. Dr. Shoichet co-founded four spin-off companies, is actively engaged in translational research and science outreach. Dr. Shoichet is the recipient of many prestigious distinctions and the first (and until recently the only) person to be inducted into all three of Canada's National Academies of Science of the Royal Society of Canada, Engineering and Health Sciences. Professor Shoichet is an Officer of the Order of Canada and holds the Order of Ontario. Dr. Shoichet is the L'Oreal-UNESCO For Women in Science Laureate for North America, 2015, Foreign Member of the US National Academy of Engineering, Fellow of the US National Academy of Inventors, recipient of the Killam Prize in Engineering, 2017 and Fellow of the Royal Society (UK). Dr. Shoichet is the NSERC Herzberg Gold Medal awardee, 2020 (the highest award in science/engineering in Canada) and recipient of the Margolese National Brain Disorders Prize. Dr. Shoichet received her SB from the Massachusetts Institute of Technology (1987) and her PhD from the University of Massachusetts, Amherst in Polymer Science and Engineering (1992).

Envisioning the future: from what if to clinical trials

We are particularly interested in advancing novel bioengineering strategies to overcome central nervous system diseases and disorders such as stroke, spinal cord injury and blindness. For the latter, we are focused on retinal detachment, glaucoma and retinitis pigmentosa, all of which result in blindness. We invented a vitreous substitute hydrogel to match the biochemical and physicochemical properties of the native vitreous to treat retinal detachment. Hyaluronan-oxime is non-swelling, biocompatible and bioresorbable, as demonstrated in rabbit eyes. It also serves as an excellent delivery vehicle as it is easily injectable through fine needles. We chemically modified timolol, a well-known glaucoma drug, to a prodrug and formulated it into colloidal drug aggregates, enabling prolonged delivery to the eye when injected in HA-oxime and sustained reduction of intraocular pressure in rats. Rod-derived cone viability factor (RdCVF) was discovered by the Leveillard lab to preserve the viability of cone photoreceptors after rod photoreceptors die in retinitis pigmentosa. We re-engineered RdCVF as a fusion protein and modified HA-oxime with peptides to allow its affinity-controlled release. In 3 different models of retinitis pigmentosa, we demonstrate greater cone viability and functional improvements, demonstrating a gene-agnostic strategy for this complex family of genetic mutations.



Ben Zhong Tang

The Chinese University of Hong Kong,

Shenzhen, China

Prof. Tang received his B.S. and PhD degrees from South China University of Technology and Kyoto University in 1982 and 1988, respectively. He conducted postdoctoral research at The University of Toronto from 1989 to 1994. He joined the Hong Kong University of Science & Technology in 1994 and was promoted to Chair Professor in 2008. He was elected to the Chinese Academy of Sciences in 2009 and the World Academy of Sciences for the Advancement of Science in Developing Countries in 2020. In 2021, he joined The Chinese University of Hong Kong, Shenzhen, as Dean of School of Science and Engineering, with a concurrent appointment of X.Q. Deng Presidential Chair Professor.

Prof. Tang has published >2,600 scientific papers, which have been cited >234,000 times. His h-index is 211. He has delivered >500 invited talks at international conferences and has been granted >100 patents. He is currently serving as Editor-in-Chief of *Aggregate* published by *Wiley*, and is sitting in the editorial boards of >20 scientific journals.

Prof. Tang is mainly engaged in the study of materials science, macromolecular chemistry and biomedical theranostics. He coined the concept of aggregation-induced emission (AIE), and his labs are spearheading the AIE research in the world.

Prof. Tang has been listed as a Highly Cited Researcher in both areas of Chemistry and Materials Science since 2014. He received a series of awards, scholarships and honors, e.g., Croucher Senior Research Fellowship Award in 2007 and the Chinese Chemical Society's Wang Baoren Award for Basic Research in Polymer Science. In 2014, he was awarded the 27th Khwarizmi International Science Award. In 2015, he was honored as the Honorary Citizen of Guangzhou. In 2017, Prof. Tang was awarded the National Natural Science Award (1st Class) , along with the Scientific and Technological Progress Award (Ho Leung Ho Lee Foundation). In 2020, he received the MCF Best Review Award. In 2021, he was honored with the *Nano Today* International Science Award and several editorial commendations, including the Outstanding Reviewer award from *Materials Chemistry Frontiers*. In 2022, he received the NPY Webinar Certificate. In 2023, he received the *Biomaterials* Global Impact Award, the NJU-ACS Certificate, and the designation of World Leading AI Scientist by the International Artificial Intelligence Industry Alliance..and CCS–SINOPEC Award (the Chinese Chemical Society) in 2024.

Conceptually New AIEgen-based Theranostic Systems

Advanced bioprobes are highly demanded for biomedical research and theranostic applications. Fluorescence is useful for in-situ visualization of biostructures and real-time monitoring of bioprocesses. The fluorescence from conventional organic dyes is often weakened in the aggregate state, leading to the aggregation-caused quenching (ACQ) effect. We have developed a conceptually new anti-ACQ system, where the fluorogens are almost non-fluorescent when molecularly dissolved but become highly emissive when nanoscopically aggregated. This effect is named aggregation-induced emission (AIE). With their remarkable advantages of high emission efficiency, low background noise, excellent photostability and large Stokes' shift, the fluorogens with AIE attribute (AIEgens) have been utilized as new bioprobes. In this talk, I'll illustrate the biomedical applications of the AIEgens for in vitro sensing and imaging and in vivo diagnostics and therapy.

Li Tang

EPFL, Switzerland

Li Tang received his B.S. in Chemistry from Peking University, China, in 2007, and Ph.D. in Materials Science and Engineering from University of Illinois at Urbana-Champaign, USA, in 2012, under the supervision of Prof. Jianjun Cheng. He was a CRI Irvington Postdoctoral Fellow in the laboratory of Prof. Darrell Irvine at Massachusetts Institute of Technology during 2013-2016. He joined the faculty of Institute of Bioengineering, and Institute of Materials Science & Engineering, at École polytechnique fédérale de Lausanne (EPFL), Switzerland, as a Tenure-Track Assistant Professor in 2016, and promoted to Associate Professor with tenure in 2022. He is also the Vice Dean for Innovation, and Director of Innovate4Life program at School of Life Sciences, EPFL.

His research focuses on developing multidimensional immunoengineering approaches for enhanced cancer immunotherapies. Dr. Tang is the recipient of Friedrich Miescher Award (2025) from Life Sciences Switzerland (LS2), Leenaards Prize for Translational Medical Research (2025), Biomaterials Science Lectureship (2025), CAB Mid-Career Investigator Award (2024), Biomaterials Award for Young Investigators (2024), Cancer Research Institute CLIP Award (2021), Anna Fuller Award (2021 and 2022), European Research Council (ERC) Starting Grant Award (2018), and named in the MIT Technology Review's "Top 35 Innovators under Age 35" list of China region (2020).

Multidimensional immunoengineering approaches to enhance cancer immunotherapy

Our immune system interacts with many diseases in a multidimensional manner involving substantial biological, chemical, and physical exchanges. Manipulating the disease-immunity interactions may afford novel immunotherapies to better treat diseases such as cancer, an emerging field termed ‘immunoengineering’. My lab aims to develop novel strategies to engineer the multidimensional immunity-disease interactions to create safe and effective therapies against cancer. We leverage the power of metabolic and cellular bioengineering, synthetic chemistry and material engineering, and mechanical engineering to achieve controllable modulation of immune responses. In this talk, I will first discuss our discovery of a new type of immune checkpoint with mechanical basis that is distinct from most known immune checkpoints of biochemical traits. We further developed novel interventions to overcome the mechanical immune checkpoint for enhanced cancer immunotherapy. Next, I will talk about our recent discovery of IL-10 and IL-4, type 2 immune function-related cytokines, as metabolic reprogramming agents that reinvigorate the terminally exhausted CD8+ tumor infiltrating lymphocytes. This strategy has been extended to developing metabolically armored CAR-T cells with IL-10 secretion to counter exhaustion-associated dysfunction in the tumor microenvironment for enhanced anticancer immunity. This new CAR-T cell therapy, i.e. IL-10-secreting CAR-T, has shown promise in several on-going IIT clinical trials (NCT06393335, NCT05715606, NCT05747157, NCT06120166, NCT06277011) in the treatment of refractory/relapsed CD19+ B cell leukemia and lymphoma, and lupus.

Sihong Wang

The University of Chicago, USA

Sihong Wang is an Associate Professor in the Pritzker School of Molecular Engineering at the University of Chicago, USA. He received his Ph.D. degree in Materials Science and Engineering from the Georgia Institute of Technology in 2014, and his Bachelor's degree from Tsinghua University in 2009. From 2015 to 2018, he was a postdoctoral fellow in Chemical Engineering at Stanford University. He has published over 80 papers in numerous high-impact journals, including *Science, Nature, Nature Materials, Nature Electronics, Nature Sustainability, Matter, Nature Communications, Science Advances,* etc. His research group currently focuses on soft polymeric bioelectronic materials and devices as the new generation of technology for biomedical studies and therapeutics. As of July 2025, his research has been cited more than 30,600 times and he has an H-index of 668. He was recognized as a Highly Cited Researcher by Clarivate Analytics from 2020 to 2024, and was awarded the NIH Director's New Innovator Award, NSF CAREER Award, Office of Naval Research (ONR) Young Investigator Award, MIT Technology Review 35 Innovators Under 35 (TR35 Global List), Chan Zuckerberg Biohub Investigator Award, Advanced Materials Rising Star Award, ACS PMSE Early-Stage Investigator Award, iCANX Young Scientist Award, MRS Graduate Student Award, Chinese Government Award for Outstanding Students Abroad, Top 10 Breakthroughs of 2012 by Physics World, etc.

Bioelectronic Materials for Tissue-Interfaced Continuous Biosensing

In vivo recording of biochemical information, such as metabolites, proteins, cytokines, and transcription factors, offers the most direct and information-rich window into biological processes and physiological status, from inflammation and immune dynamics to neural activity. Yet achieving continuous biochemical sensing at tissue interfaces with meaningful spatiotemporal resolution remains a major unsolved challenge. Current biosensing technologies face a wide spectrum of limitations, including mechanical invasiveness, poor tissue attachment, biofouling, chronic immune responses, and insufficient sensitivity for low-abundance biomarkers such as cytokines. My group has recently developed hydrogel semiconductors as a new materials platform that has the potential to address these barriers in an integrated manner. These materials combine several key properties—bioadhesion, intrinsic immune-compatibility, ultrasoft and stretchable mechanics matched to tissues, and 3D volumetric bioreceptor functionalization that enables high sensitivity at low analyte concentrations. In this talk, I will introduce the design principles behind these bioelectronic materials and highlight our recent progress toward tissue-interfaced, continuous, and multiplexed biosensing with significantly extended in vivo stability. Moving forward, these advances may lay the foundation for a new generation of adaptive, intelligent bioelectronic interfaces that continuously map the biochemical state of living systems.

Joy Wolfram

The University of Queensland, Australia

Associate Professor Joy Wolfram leads an extracellular vesicle research program (A$260M as chief investigator), which has amassed over 19 500 citations. Her team's mission is to translate next-generation nanomedicine directly to the clinic, transforming the treatment of life-threatening diseases, improving patient outcomes, and extending healthy lifespans. She holds joint appointments in the School of Chemical Engineering and the Australian Institute for Bioengineering and Nanotechnology at The University of Queensland (ranked 41st globally by U.S. News & World Report) and cofounded the UQ Centre for Extracellular Vesicle Nanomedicine, the largest centre of its kind in Australia. In the past five years, Wolfram has ranked in the top 1 percent of researchers in several distinct fields: cancer, extracellular vesicles, drug delivery, biology/biochemistry, and pharmacology/toxicology (Essential Science Indicators SciVal and ScholarGPS). Wolfram's interdisciplinary team includes clinicians, and she holds an affiliate position at Houston Methodist Hospital (ranked top 20 in the U.S. by U.S. News & World Report). Wolfram is a passionate science communicator who formerly chaired an education and outreach working group at the National Institutes of Health (U.S.), served as associate program director of the PhD Program in Regenerative Sciences at Mayo Clinic (ranked 1st globally by Newsweek), and shares her work with broader audiences as a TED speaker.

Extracellular vesicles as next-generation medicines

Extracellular vesicles are cell-released biomolecular packages that play important roles in intercellular communication. Extracellular vesicles have promising potential to outperform conventional pharmaceuticals due to versatile bioactive cargo. The extracellular vesicle field has a projected global market size of over $2.2B USD in 2030 (Emergen Research). My team is realising the potential of extracellular vesicles as effective, scalable, and safe therapeutics to alter the trajectory of life-threatening diseases. We are leveraging our key discoveries in extracellular vesicle manufacturing and the use of extracellular vesicles as drug carriers to enable clinically feasible and multitargeted approaches for treating disease, improving patient outcomes, and prolonging healthy lifespan.

Xiyun Yan

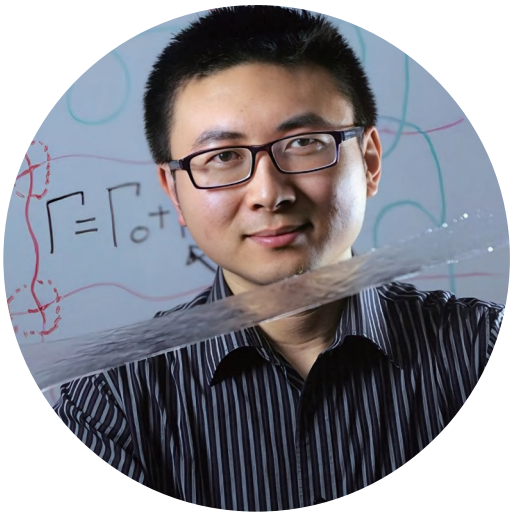
Institute of Biophysics, Chinese Academy of Sciences (IBP), China

Dr. Yan's research group focuses on precision cancer treatment, with emphasis on studies related to selecting new targets for tumors, finding new material for drug delivery and developing new strategies to combat cancer. She introduced the concept of "nanozyme" and used nano-materials as enzyme mimics to create new methods for tumor diagnosis and nanozyme-strip for rapid local detection of infectious diseases such as Ebola virus. She has also established the standard for determining nanozyme catalytic activity, founded Nanozyme Academic Subgroup of Biophysical Society of China and developed world's first nanozyme product. Her discovery of nanozymes changed the general view that nanoparticles are biochemically inert and opened many new applications for nanozymes as enzyme mimics in various major fields, which include medicine, agriculture, food production, biotechnology, and environmental protection. Dr. Yan's original research, published in 2007, has received widespread recognition, accumulating over 6,900 citations. Her work has paved the way for the emergence of the interdisciplinary field of nanozymes, bridging the disciplines of enzymology, chemistry, materials science, biology, and medicine. Since then, more than 1,500 nanozymes have been reported by 500 laboratories across 55 countries. The research on nanozymes has expanded from laboratory settings to clinical and agricultural applications. The significance of nanozymes has been acknowledged by Clarivate, which designated it as a "key hot frontier" in 2022. Additionally, the International Union of Pure and Applied Chemistry (IUPAC) recognized Nanozyme as one of the top ten new technologies in 2022, and the World Economic Forum listed Nanozyme among the Top 10 Emerging Technologies of 2025.

Dr. Yan's innovative contributions in the discovery and application of nanozymes have earned her a position among the top 2% of highly cited scientists worldwide in 2022, 2023 and 2024. In 2012, she was awarded the second prize of the State Natural Science Award and received the Atlas Award, 2015.

Nanozyme, a new biological catalyst and its applications

Nanozymes are defined as a class of nanomaterials possessing intrinsic biocatalytic functions. Their nanostructures enable them to catalyze the reactions as natural enzymes. Since their initial report in 2007 in Nature Nanotechnology, over 500 research groups from 55 countries have validated this phenomenon. The discovery of nanozymes represents a groundbreaking finding, showcasing the unique biological effects of nanomaterials—namely, enzyme-like activity. This discovery has spurred the emergence of nanozyme studies as a novel interdisciplinary field, bridging material science, chemistry, biology, medicine, and theoretical calculations. Advances in understanding nanozyme catalytic mechanisms and structure-activity relationships have facilitated the rational design of nanozymes with enhanced specificity and activity. As a new class of biocatalysts combining the power of chemical catalysis and natural enzymes, nanozymes has been widely used in biology, medicine, agriculture, national defense, and beyond. Their utility has expanded from initial detection applications to encompass nanozyme catalysis in medicine, green synthesis, new energy, environmental protection, and more. Leveraging their unique properties, such as low-temperature catalysis and multi-activity cascades, nanozymes are poised to continue driving advancements in cutting-edge technologies and products development, ultimately contributing to advancements in human health and the enhancement of overall quality of life.Over 18 years of development, the world's first nanozyme products have been developed, accompanied by thousands of publications on nanozyme science, the establishment of nanozyme terminology, and the formulation of Chinese and international standards. Notably, nanozymes hold substantial potential for in vivo applications, with catalytic biomedical uses ranging from anti-tumor and antibacterial therapies to the treatment of ischemic stroke and neurodegenerative diseases, some of which have already demonstrated potential for clinical translation. Moreover, recent findings of natural nanozymes functioning as antioxidant reagents in living organisms, their potential roles in the origin of life, as well as their potential pathological roles in human diseases, may further inspire future studies of nanozymes.



Xuanhe Zhao

Massachusetts Institute of Technology, USA

Xuanhe Zhao is the Uncas and Helen Whitaker Professor at MIT. The mission of Zhao Lab is to advance science and technology between humans and machines to address grand societal challenges in health and sustainability. Dr. Zhao is a Humboldt Research Award winner and a fellow of American Institute for Medical and Biological Engineering (AIMBE). He co-founded three startup companies – SanaHeal, Magnendo, and Sonologi – based on technologies developed in Zhao Lab. Bioadhesive ultrasound, based on Zhao Lab's work published in Science, was named one of TIME Magazine's Best Inventions of the year in 2022. SanaHeal Inc., based on Zhao Lab's work published in Nature, was awarded the 2023 Nature Spinoff Prize. Over 15 patents from Zhao Lab have been licensed by companies and have contributed to FDA-approved and widely used medical devices globally.

Merging Humans and Machines: Innovation and Translation

Whereas human tissues and organs are mostly soft, wet, and bioactive, machines are commonly hard, dry, and abiotic. Merging humans and machines is of critical importance in addressing grand societal challenges in AI, health, environment, security, education, and happiness in life. However, merging humans and machines is extremely challenging due to their fundamentally contradictory properties. At the MIT Zhao Lab, we invent, study, and translate soft materials and systemsto form long-term, robust, non-fibrotic, and high-bandwidth interfaces between humans and machines. In this talk, I will discuss two examples of merging humans and machines by posing two challenges in science and technology:

- Can implantable devices avoid inducing fibrous capsules over many years?
- Can wearable devices continuously image and stimulate deep organs over several days?

I will conclude the talk with a vision for the future convergence of humans and machines—especially between humans and AI.

Yuliang Zhao

National Center for Nanosciences and

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Professor of Chemistry, Chinese Academy of Sciences (CAS). He served as the Director of National Center for Nanosciences and Technology, China (2008-2023), the Academic Director of Suzhou Institute of Nano-tech and Nano-bionics, CAS (2009-2023). He graduated from Sichuan Univ. in 1985, and received PhD at Tokyo Metropolitan Univ. in 1999. He moved to Chinese Academy of Sciences from RIKEN in 2001. He and colleagues in Japan discovered the Element 113 (Nh) which is first element that has been discovered in Asia and filled in the Element Periodic Table.

Dr Zhao is a pioneer for initiating the study on biological/toxicological effects of nanomaterials in 2001 and a trailblazing pioneer on the research of in vivo drug delivery using nanorobots. He is an international leader who has made pioneering and seminal contributions to the field of nanotoxicology by developing innovative techniques, tools, methodologies, standards, regulations to discover toxicological effects of nanomaterials and biomedical activities of nanoparticles for drug delivery, understanding their mechanisms of nanotoxicity in clinical applications. Dr Zhao`s basic research work has published ~660 peer-review scientific papers with citations ~90,000 times (H-index ~150); edited and published 13 books (3 books in English and 10 in Chinese), with his earliest efforts on systematizing the knowledge for nano-toxicology in category of nanomaterials, making significant contribution to building the knowledge framework of nano-safety.

In applications, Dr Zhao has been authorized 131 patents by China, USA, EU and Japan, and more than 20 patents have been translated to industries. The work of his team has led to an ISO standard being adapted by ISO/IEC 168 countries. etc. He is also worldwide leader in forging a comprehensive knowledge framework in nanotoxicology, enabling the scientific and regulatory landscape for nanotechnology products of biomedical uses in clinics. These greatly promoted the clinical translations of new bio-nanomaterials and later became the key of establishing the regulatory guidelines of nano-drug administration, for example, supporting the fast approval of Covid-19 mRNA Vaccine for clinical uses worldwide.

Particulate Chemical Biology in Drug Delivery: Partichemobiology

Recently, the carrier technologies are developed spreadly for drug, vaccine, gene, gene editing tools, proteins and large molecules delivery, etc. and expedites the pharmaceutical innovations. Delivery carriers as key biomaterials functioned with physiological or pathological barriers penetration, tumor-specific targeting, cancer microenvironmentally responsible, offer revolutionary strategies and ways for solving long-standing medicine and clinical issues in treating major human diseases. The core of this promising new technology is the delivery carrier, which are mostly nanoscale particles manufactured chemically or biologically. These nanoparticles are actually the particulate form self-assemblied from atoms` aggregates, ions` aggregates, or molecules` aggregates. However, the aggregation makes their chemical activities and biological effects of the nanoscale particulates completely different from their original forms as atoms, ions or molecules, respectively.

Over the past two decades, our research has uncovered some unique underlying mechanisms of carriers' activities in vivo, like size-effect, surface-effect, interface-effects, the ETR effects in ADME, target molecules, metabolic dynamics, penetrating bio-barriers, and therapeutic outcome, etc., that have redefined the paradigms of nanoscale biomaterials in vivo.

In this talk, we discuss some surprising experimental findings showing how difference of the chemical activities in vitro or biological effects in vivo of nanoscale carriers from their original forms as atoms, ions, or molecules. Then we propose a new interdisciplinary frontier research field, Partichemobiology, it is the Particulate Chemical Biology (Partichemobiology), studying chemically biological activities and effects of carriers for drug (vaccine, gene, gene editing tools, proteins and large molecules, etc.) delivery. They are key to advance next-generation biomaterials or revolutionary medicines. In addition, the development of methodology and theory for partichemobiology is also crucial for promoting innovative research on the in vivo biological behavior of environmental particles on Earth, the Moon, or Mars.

Abstract of Lecture (Short Talk)

Decellularized Tissue Engineering Hyaline Cartilage Graft for Articular Cartilage Repair and Its Forward-Looking Test for Space Medicine

Dongan Wang

The Chinese University of Hong Kong, China

Articular hyaline cartilage, a tissue articulating skeleton at joints, is highly prone to damages caused by trauma, diseases and ageing; once injured, its self-regeneration is difficult and slow due to the avascular nature. To repair and regenerate damaged articular cartilage, we have innovatively developed decellularized tissue engineering hyaline cartilage graft (dLhCG). Good osteochondral defect healing and complete integration with adjacent native cartilage in in-situ implantation of dLhCG samples in large animal models. Investigative clinical trials have been completed in China with positive performance. Besides, a forward-looking space experiment is designed and performed with dLhCG for future space medicine too.

Transcriptome-Guided Materiomics for the Rational Design of a Tenogenic Hydrogel Niche

Dan Michelle Wang

The Chinese University of Hong Kong, China

Bioengineered hydrogels offer immense potential as artificial niches to direct stem cell-mediated tendon regeneration. However, their rational design is confounded by a critical challenge: the vast, complex parameter space of material features that govern tenogenic differentiation. Without a clear understanding of how these parameters interact, the field has relied on empirical, iterative optimization—a process fraught with protracted timelines and substantial resource burdens. As such, there is a pressing need for a paradigm shift from intuitive tailoring to a predictive framework for tendon biomaterial design.

To address this, we introduce a data-driven materiomics strategy that transcends conventional trial-and-error. By integrating in-house RNA-sequencing with advanced bioinformatics and mathematical modelling, we quantitatively deconstruct the tenogenic response of adipose-derived stem cells to systematically modulated features of a tendon-mimetic hydrogel (TenoGel). This integrated approach not only identified the optimal conditions for key parameters, including tendon extracellular matrix concentration, uniaxial tensile loading, and pre-conditioning duration, but also establishes a predictive model for stem cell fate in response to untested design features.

The resultant optimized TenoGel strongly promoted tenogenic differentiation in vitro and, crucially, achieved significant functional regeneration in a rat tendon injury model, all while concurrently suppressing undesired ectopic ossification.

Thus, our RNA-seq-based materiomics strategy establishes a new paradigm for biomaterial development. This predictive framework can be integrated into existing fabrication pipelines to systematically engineer customized, high-efficacy biomaterials. By moving beyond traditional trial-and-error, this approach accelerates the creation of translatable therapies not only for tendon regeneration but for a broad spectrum of tissue engineering application.

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Functional Nanoparticles Adapted with biomedical effects for controllable delivery in vivo

Xing-Jie Liang

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China

Tolerance to immunotherapy is one of the obstacles in the therapeutic failure of metastasis cancer and infectious disease treatments with advanced therapeutics in clinic. Targeted delivery of vaccines to dendritic cells (DCs) for improved vaccination efficacy remains challenging. Compared to traditional drug delivery systems, nanoscale immune-engineering delivery systems (NIEDS) have greater potential in many areas, such as multiple targeting functionalization, combined drugs delivery, longer circulation time and systemic control release. NIEDS incorporating stimulus-responsive biopolymer have remarkable properties which allow them to bypass biological barriers and achieve targeted intracellular drug delivery. NIEDS can be employed for the efficient delivery of both peptide- and message RNA (mRNA)-based preventive or therapeutically vaccines. This presentation describes the characteristic features of nanostructure for the bio-/med- applications and their mechanisms with the aid of nanoparticles for the development of newer drug delivery systems to treat effective in vivo.

Materials for tissue engineering based on controlled network topology

Guosong Chen

Fudan University, China

The dynamic hydrogels with biomimetic viscoelastic properties are regarded as ideal materials for wound treatment because they provide the appropriate mechanical environment to promote tissue regeneration. However, due to the existence of dynamic interactions, the hydrogel modulus can only be regulated in a small range which cannot meet the needs of wound repair in different tissues. Therefore, it is necessary to develop new methods for large-scale regulation of dynamic hydrogel modulus to support treatment for multiple wounds. The project intends to change the topology of the hydrogel network through the design of polymer branching structure to regulate the topology
structure and distribution. With the help of molecular dynamics simulation and entropy elasticity theory calculation, the mechanism in the network to achieve compensation up-regulation and down-regulation has been explored. Consequently, a new method for large-scale regulation of hydrogel modulus has been established. Animal models of different tissue trauma will be used to establish the structure-activity relationship between material structure and tissue regeneration, revealing the biological significance of large-scale modulus regulation. This project will lay a foundation for the establishment of universal trauma treatment methods based on materials for tissue engineering. Both the dynamic interactions and the loops in the hydrogel network can lead to modulus downregulation as working as independent elements. However, the coupling mechanism
between them has not been reported. Therefore, this project proposes to combine the loops with dynamic interactions to form dynamic loops which can change the downregulation of themselves and can greatly broaden the range of hydrogel modulus.

Atomically Precise Metal Clusters Enable High-Fidelity Clinical Neural Recording and Early Seizure Detection: the first-in-human study

Xiaodong Zhang

Tianjin University, China

Implantable neural electrodes are pivotal for clinical interventions in neurological disorders. However, the widely used clinical PtIr electrodes suffer from intrinsically low signal sensitivity and limited long-term biocompatibility, primarily due to transport barriers between electronic and ionic currents at the electrode-tissue interface. Here, we functionalize clinical PtIr electrodes with atomically precise, semiconductor-like metal clusters that act as charge-storage units and energy transducers. This interfacial engineering markedly enhances electrochemical performance, yielding a 3.3-fold reduction in impedance and an 8.6-fold increase in charge transfer currents. In a large-animal canine model, the modified electrodes achieve a 10-fold improvement in neural signal sensitivity without observable adverse effects. In clinical recordings spanning 300 channels across 20 epilepsy patients, a consistent 9.5-fold enhancement in sensitivity is observed. The heightened signal fidelity enables reliable detection of latent period neural signatures, supporting earlier diagnosis. Notably, when integrated with artificial intelligence, the seizure-prediction horizon extends from 0.5 hours to several hours. Comprehensive safety assessments in patient reveal no detectable alterations in serum biochemical, hematological parameters, and systemic inflammatory markers, and no Au ions are detected in peripheral blood, demonstrating excellent biocompatibility and negligible risk of metal ion release. These results underscore the strong translational potential of this technology for next-generation neuromodulation and seizure management

Cell-adaptable dynamic hydrogels for biomedical applications

Liming Bian

South China University of Technology, China

Conventional hydrogels, typically covalently crosslinked, have restrictive network structures that inhibit key cellular activities including proliferation, migration, and assembly in 3D culture. In contrast, biopolymer-based supramolecular hydrogels, which are usually formed via self-assembly of physically interacting biopolymers, are usually weak as shown in “inverted vials” instead of freestanding 3D constructs and less stable than chemical hydrogels. We have developed a patented technology for preparing cell-adaptable supramolecular hydrogels crosslinked with reversible physical bonds and chemically-defined composition. These hydrogels can effectively support the rapid proliferation, excessive cell migration, and timely assembly of varying cell types including stem cells, tumor cells, endothelial cells, and neural cells encapsulated within the 3D hydrogel matrix. As the result, these hydrogels can promote the formation of different organoids including tumor, blood vessel, skin, nerve, etc. Mechanistically, these cell-adaptable hydrogels enhance the mechanosensing-dependent cytoskeletal remodeling, metabolic activity, and paracrine function of encapsulated cells, which are essential to various developmental processes. Furthermore, free from the interference from unknown and unpredictable biological factors typically found in other commercial hydrogels used for organoid culture, the chemical composition our synthetic supramolecular hydrogels are well-defined and therefore highly desirable for the culture of organoids intended for drug testing and screening. The degradable version of our hydrogel can be degraded within 10 mins by a cell-compatible small molecule without using trypsin to retrieve the cultured cell/organoids without harming the cell surface markers. We further demonstrate that such hydrogels supported in situ tissue regeneration via the delivery of therapeutic cells and drugs. Such dynamic hydrogels are not only desirable for potential clinical applications but also useful for 3D culture of cells and organoids to assist basic studies.

A Triple-Layer Microfluidic Microphysiological System to Model USH2A-Associated Retinal Diseases and Identify Novel Therapeutic Targets

Hon Fai Chan

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Mutations in the USH2A gene cause both non-syndromic Retinitis Pigmentosa (RP) and multi-systemic Usher Syndrome Type II (USH II), yet modeling this complexity in vivo and in vitro remains a challenge. Due to species differences, the applicability of in vivo animal data to human biology and disease modeling is limited. While organoid represents a promising in vitro model, current organoid models lack the multi-tissue interactions crucial for recapitulating the pathogenesis. of retinal diseases. To address this, we developed a novel triple-layer microfluidic chip (RPVC) for the long-term (>200 days) co-culture of patient-derived retinal organoids (ROs), retinal pigment epithelium (RPE), and vascular organoids (VOs). This system was used to investigate disease mechanisms in USH2A-mutant organoids.

We demonstrated that developmental defects in USH II-ROs were more severe than in RP-ROs, manifesting as impaired photoreceptor structure and reduced expression of key proteins RHO and SAG. Multi-omics analysis (transcriptomics and proteomics) revealed that the USH2A (c.8559-2A>G) mutation, which causes exon 43 skipping, led to elevated expression of the mitochondrial dysfunction factor CHCHD2. This upregulation induced widespread apoptosis across retinal cells. Therapeutically, targeting this pathway with the anti-apoptotic agent APS4 successfully reversed pathological features in USH II-ROs and alleviated retinal degeneration in USH2A-/- mice.

Collectively, our integrated RPVC platform provides a powerful human-relevant model to unravel the multi-tissue pathology of USH2A-related diseases. We identify CHCHD2-mediated apoptosis as a central disease mechanism and validate APS4 as a promising therapeutic candidate for these currently incurable conditions.

Remotely Controllable Biomolecular Self-Assembly for Cancer and Regenerative Therapy

Heemin Kang

Korea University, Korea

For translational cancer therapy, targeting efficiency of nanoparticles remains low for intractable tumours, including physical barriers of dense fibrous extracellular matrix, yielding poor anti-tumour efficacy and off-target toxicity. Furthermore, poor biodegradation of inorganic nanoparticles and biodegradation of synthetic molecules exert toxicity. In the first half of the talk, I will describe magnetic supra-biomolecular self-assembly nanoparticles with negative charges formed via octahedral coordination geometry between magnetic trivalent metal ions and hydrophilic ligands prevalently occurring in the human body. They function as fully biodegradable non-toxic carrier-free biomolecular therapeutics mediating real-time imaging-guided magnetic field-regulated targeting, retention, and synergistic ferroptosis therapy for pancreatic tumour and osteosarcoma following intravenous injection.

For translational regenerative therapy, implants yield incomplete integrated tissue regeneration due to inability of establishing dynamic firm connection with native tissue, yielding limited clinical outcomes in bone union formation and integrated hard-soft tissue regeneration. In the second half of the talk, I will present magnetic supra-biomolecular self-assembly aggregates with neutral charges formed via tetrahedral coordination geometry between magnetic divalent metal ions and hydrophobic ligands prevalently occurring in the human body. They act as carrier-free biomolecular implant therapeutics with complete biodegradability and non-toxicity enabling magnetically induced dynamic connection with native tissue and synergistic complete bone union formation in segmental bone defect.

Furthermore, magnetically controllable supra-biomolecular self-assembly can yield complex structures, which include hierarchically organised chiral structures, for controlling complex-structure-specific unique motion enabling unprecedented modalities in mechanical biomedical therapies. They can be economically mass-produced reproducibly for effective and safe therapeutics for potentially overcoming unsolved clinical hurdles.