이화여자대학교
자율운영중점연구소
Basic Sciences Research Institute

BK21 FOUR
BK21 Innovative BioPharmChem
Convergence Education
And Research Program

2026 Frontiers in Nanomedicine & Biosensing

Thurs., November 19, 2026

Ewha Student Union Small Theater (Room B101)



Organizers: Ewha Basic Sciences Research Institute
BK21 Innovative BioPharmChem Convergence Education And Research Program

이화여자대학교
EWHA WOMANS UNIVERSITY

이화여자대학교
자연과학대학

2026 Frontiers in Nanomedicine & Biosensing

Date: 2026. 11. 19. Thurs.

Venue: Ewha Student Union Small Theater (Room B101)

Opening		
14:00 ~ 14:10	**Opening Address**	Prof. Dong Ha Kim, Ewha Womans University Prof. Young Joo Kwon, Ewha Womans University
Session I		
14:10 ~ 14:50	Seeing the Unseen: Generative and Predictive Artificial Intelligence for Cancer Imaging	Jang Hwan Choi
14:50 ~ 15:30	Novel Biomimetic Catalysis and Immunotherapy	Xiaogang Qu
15:30 ~ 16:10	From polymer brushes to sustainable metamaterials	Andreas Fery
16:10 ~ 16:30	**Break (Photo Time)**	
Session II		
16:30 ~ 17:10	Engineering the Future of Precision Brain Health: From Neural Circuits to Personalized Medicine	Hyang Woon Lee
17:10 ~ 17:50	Nanomedicine via K-BIGHEART	Lee, Luke Pyung Se
17:50 ~ 18:00	**Closing Remarks**	



Biography of Prof. Jang-Hwan Choi

Professor Jang-Hwan Choi received his Ph.D. from Stanford University in 2015. After postdoctoral research at Stanford Medicine and a Senior Researcher position at ETRI, he joined Ewha Womans University in 2017, where he is an Associate Professor of Artificial Intelligence. He leads the Visual Intelligence Lab (http://bioe.ewha.ac.kr/), focusing on medical computer vision and data-driven AI.

Dr. Choi has published over 100 articles in leading journals and conferences, including AAAI, ICDM, IPMI, CVPR, and MICCAI. He holds 30 patents and has completed five technology transfers (one international). His research is supported by national R&D programs and National Research Foundation grants. He directs Ewha's AI Convergence Innovative Talent Development Center and serves as General Chair of the International Forum on Medical Imaging in Asia (IFMIA), Organizing Chair of the Korean SIIM Annual Conference, and Organizing Chair of multiple MICCAI challenges. His awards include the Orthopedic Research Society New Investigator Recognition Award (2016), KSME Bioengineering Division Outstanding Early-Career Researcher Award (2024), and Ewha Outstanding Research Achievement Award (2024). He was selected as a Rising Ewha Fellow (2026).

Seeing the Unseen: Generative and Predictive Artificial Intelligence for Cancer Imaging

Jang-Hwan Choi, Ph.D.

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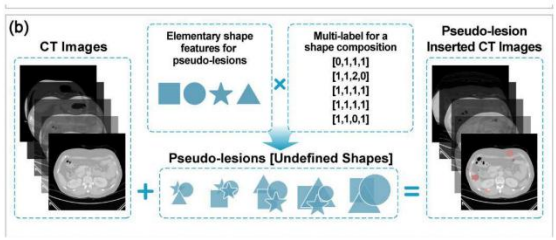
ABSTRACT

Pancreatic cancer remains one of the deadliest malignancies, with a 5-year survival rate of about 13%, largely because tumors are clinically silent and difficult to recognize on contrast-enhanced computed tomography (CT) until they are advanced. Deep learning has reached expert-level detection on curated benchmarks [6,7], yet three gaps separate benchmark performance from clinical impact: the scarcity of expert annotations, the lack of evidence that algorithms help the physicians who first read the scan, and the neglect of the longitudinal course of disease. This presentation summarizes our work addressing these gaps with generative and predictive AI on multicenter CT data from the National Cancer Center and seven tertiary hospitals in Korea.

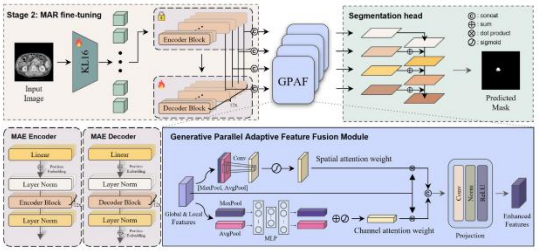
First, we use generative AI as a teacher. By inserting synthetic geometric pseudo-shapes and compositional pseudo-lesions into CT images and training transformer-based networks to segment them, we learn tumor-relevant representations without any manual annotation [1,2]. On 4,287 patients, pseudo-lesion pretraining raised classification sensitivity to 99.3% (AUC 0.95), improved the external AUC on a US cohort from 0.62 to 0.80, and, with only 10% of the labels, increased accuracy by 20.5 and sensitivity by 37.0 percentage points. Extending this idea, MARSeg pretrains a masked autoregressive generative model on CT and fuses its encoder–decoder features through parallel spatial and channel attention, achieving the best Dice scores for pancreatic tumor, colon cancer, and spleen segmentation on the Medical Segmentation Decathlon [3].

Second, we evaluate predictive AI with the physician in the loop. In a multicenter multi-reader multi-case study, ten non-radiologist physicians interpreted 100 CT examinations with and without an AI system developed on 6,358 examinations from eight institutions. AI assistance increased cancer-detection sensitivity from 0.762 to 0.933 without loss of specificity, raised inter-reader agreement (Fleiss' κ 0.40 to 0.72), and shortened interpretation time by 27%, with the largest gains for tumors smaller than 20 mm [4].

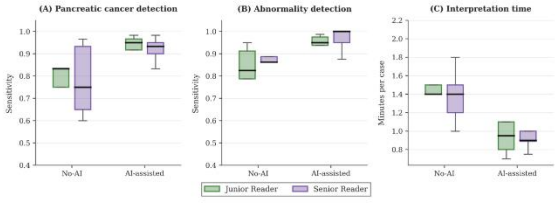
Third, we model disease across time. TeDyS conditions temporal queries on explicitly decomposed short-term (optimal-transport-aligned) and long-term (neural-ODE) dynamics to predict time-to-progression from irregularly spaced serial CT, reaching an AUC of 0.81 versus 0.71 for the best sequence baseline and transferring unchanged to longitudinal brain MRI [5]. Together, these results outline a pipeline in which generative AI supplies the labels and representations that predictive AI turns into earlier detection, more consistent reading, and personalized prognosis — and point to multimodal integration with biosensor-derived biomarkers as the next step toward pancreatic cancer screening.



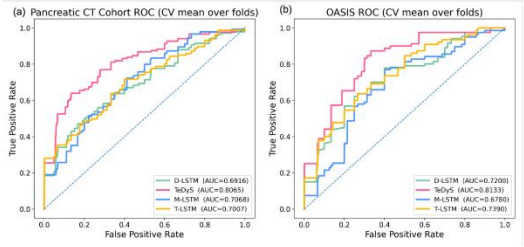
(a) Self-supervised pretraining with synthetic pseudo-lesions [1,2]



(b) MARSeg: masked autoregressive pretraining + adaptive fusion [3]



(c) AI-assisted reading by 10 non-radiologist physicians [4]



(d) TeDyS: longitudinal progression prediction (ROC) [5]

Keywords: Pancreatic cancer, Computed tomography, Self-supervised learning, Synthetic lesions, Generative models, Segmentation, Reader study, Longitudinal imaging, Progression prediction

Reference

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[2] Thanaporn Viriyasaranon,§ Jung Won Chun,§ Young Hwan Koh, Jae Hee Cho, Min Kyu Jung, Seong-Hun Kim, Hyo Jung Kim, Woo Jin Lee, Jang-Hwan Choi,* Sang Myung Woo,* "Annotation-Efficient Deep Learning Model for Pancreatic Cancer Diagnosis and Classification Using CT Images: A Retrospective Diagnostic Study", *Cancers* **2023**, *15*(13), 3392 (§: equal contribution).

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Biography of Prof. Xiaogang Qu

Prof. Xiaogang Qu, Fellow of the American Institute for Medical and Biological Engineering (AIMBE Fellow, elected 2023), the Royal Society of Chemistry (FRSC, elected 2015), Honorary Professor of University of Queensland (nominated 2017), received his Ph.D. from the Chinese Academy of Sciences (CAS) in 1995 with the President's Award of CAS. He moved to the U.S. afterwards and worked with Professor J. B. Chaires at the Mississippi Medical Center and Nobel Laureate Professor Ahmed H. Zewail at the California Institute of Technology. Since late 2002, he has been a professor at the Changchun Institute of Applied Chemistry, CAS. From 12/2006 to 05/2007, he visited the group of Nobel Laureate Professor Alan J. Heeger at UCSB. His current research is focused on ligand nucleic acids and related protein interactions and biofunctional materials for advanced medical technology. He has published over 380 articles in highly recognized journals, SCI citations by others >62,100, SCI H-Index 127; 2017-2025 elected "Highly Cited Researchers" from Clarivate Analytics; His works have been selected "Top 100 Gene therapy publications for 2006"; "The most influential paper for 2013 in China"; "Nature INDEX 2014 WFC=16.3" being highlighted; 2023 Advanced Materials Hall of Fame, etc.

Novel Biomimetic Catalysis and Immunotherapy

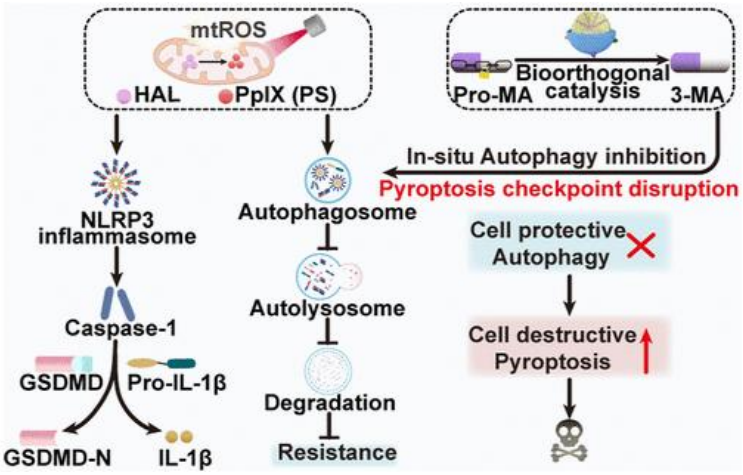
Y. Sun[1,2], M. Liu[1,2], X. Liao[1,2], C. Zhao[1,2] J. Ren[1,2], and X. Qu

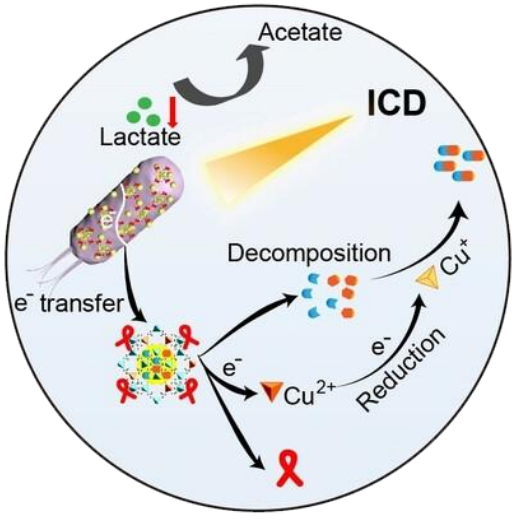
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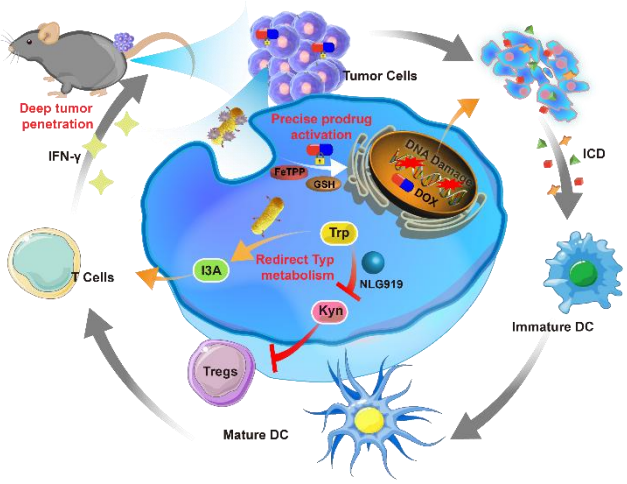
ABSTRACT

In this report, we will summarize our recent advances on the design and synthesis of biomimetic enzymes, including our design principle, catalytic analysis, determinant factors, deciphering catalytic mechanisms and their applications. We have explored broad biomimetic catalysis, especially enantioselective catalysis. Beyond biomimic enzymatic reactions, we have extended to in vivo synthesis of drugs. Recently, we have made significant progress in immunotherapy using bioorthogonal biomimetic catalysis.









Keywords: Alzheimer's Disease, Biomimetic Catalysis, Bioorthogonal Nanozyme, Cancer Therapy, Chirality, Drug Synthesis, Immunotherapy

Reference

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Biography of Prof. Dr. Andreas Fery

Prof. Dr. Andreas Fery, Leibniz-Institut für Polymerforschung Dresden e. V. (IPF), Germany, is a highly qualified and experienced researcher in the field of physical chemistry and polymer physics with a strong academic background and extensive expertise in the understanding and synthesis of colloids and interfaces, the rational design and assembly of polymer-based and nanostructured materials, and their integration into devices for sensing, bioelectronics, optoelectronics, and energy applications. His significant contributions to colloids and interfaces, particle-based materials, and plasmonics have attracted more than 20.000 citations with H-index of 80 (Google Scholar, October 2026). Amongst other functions, Prof. Dr. Andreas Fery serves as deputy spokesperson for for the Excellence Cluster (EXC) 3035 "Responsible Electronics in the Climate Change Era (REC^2)" (since 2026) and spokesperson for the Leibniz Research Alliance "Advanced Materials Safety" (since 2022).

In 2000, Prof. Dr. Andreas Fery completed his doctorate in Physics of Condensed Matter, University Potsdam/Max-Planck Institute for Colloids and Interfaces, Germany. Following his PhD, he worked in postdoctoral positions at Max-Planck Institute for Colloids and Interfaces, and Institute Curie, Paris, France. In 2006, he completed his habilitation in the field of physics of interfaces at the University of Potsdam. He subsequently became an associate professor and later a full professor in physical chemistry at the University of Bayreuth, Germany. He currently serves as Division Director for Physical Chemistry and Physics of Polymers at the Leibniz-Institut für Polymerforschung Dresden e. V. (IPF) and further holds a professorial appointment at Technical University Dresden (TU Dresden).

From polymer brushes to sustainable metamaterials

Andreas Fery* [1], Quinn Besford[1], Franziska Lissel[1,2], Tobias A. F. König[1], Alexander Münch[1], Christian Rossner[1], Ningwei Sun[1], Ziwei Zhou[1]

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ABSTRACT

Polymer surface modification offers unique possibilities for creating interactive and functional materials. Polymer brushes in particular can be employed for nanoscale control both on macroscopic surfaces and for Polymer modification of nanoparticles results in hairy nanoparticles, which find a range of applications in functional materials [1]. Especially metallic nanoparticles offer a number of interesting optical and electronic effects due to their localized surface plasmon resonance (LSPR) Adding a functional polymeric shell does not only allow controlling inter-particle distances but as well tailor transport / electronic couping. [1,2] Increasing the level of complexity, the ordering of particles at different length scales opens another powerful routes to optical and electronic functionality due to novel collective plasmonic excitations arising from plasmonic coupling effects. We focus on achieving such ordered particle arrays through self-assembly approaches. Colloidal self-assembly can indeed yield well-defined colloidal clusters and surface arrays in which coupling effects can be controlled. In particular, large-scale assemblies are possible in combination with biomimetic surface patterning like controlled wrinkling. We discuss the underlying physicochemical principles of the structure formation process and the resulting plasmonic coupling effects including chiroplasmonic metamaterial effects [3,4]. Finally, we present perspectives on how these assembly principles can be relevant for developing circular economy approaches for advanced materials.

Keywords: polymer brushes, messenger materials, plasmonics, circular dichroism, metamaterials, particle based materials, circular materials.

Reference

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Biography of Prof. Hyang Woon Lee

Prof. Hyang Woon Lee received M.D. degree from Ewha Womans University, and M.D., Ph.D. degree in the Department of Medicine (Neurophysiology) at Korea University in 1999. She carried out postdoctoral researches in the Neurology Department at Johns Hopkins University Medical School with Prof. Ronald P. Lesser and in the Clinical Epilepsy Section at the National Institute of Neurological Disorders and Stroke (NINDS) with Prof. William H. Theodore. Then, she joined the Department of Neurology at Ewha Womans University Medical School as an Assistant Professor since 2003 as a Neurologist, specialized in patients with Epilepsy, Sleep disorders, and Cognitive dysfunction. She currently is a Professor of Neurology, director of Epilepsy and Sleep Center, and director of Ewha Institute of Biomedical Sciences. Her research interests include epilepsy, sleep, human brain mapping, multimodal neuroimaging with quantitive EEG monitoring, development of neuromodulation therapy using electrical, magnetic, and focused ultrasound stimulation technologies for various neurological disorders. Currently, she serves as chair of Women Special Interest Group of Organization of Human Brain Mapping (OHBM) since 2024, and president-elect of Korean Human Brain Mapping (KHBM) this year. She also serves as an Associate Editor of *Neuroimage*, Editorial Board Member of *Sex- and Gender-specific Biomedical Sciences*.

Engineering the Future of Precision Brain Health: From Neural Circuits to Personalized Medicine

Hyang Woon Lee

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ABSTRACT

Brain Network Science and Noninvasive Neuromodulation - Brain function is governed not only by individual brain regions but also by complex interactions across distributed neural networks. We explored the integration of structural and functional brain connectivity to understand large-scale brain networks, including the default mode network (DMN). We further investigated the potential of transcranial focused ultrasound stimulation (tFUS) as a noninvasive approach to modulating human brain networks and its implications for future therapeutic applications [1].

Genetic and Biological Mechanisms of Sleep and Circadian Rhythms - We explored the genetic and biological determinants of sleep, including genome-wide identification and functional validation of genes associated with sleep duration [2]. We also examined circadian and multidien rhythms of epileptiform activity and seizures in temporal lobe epilepsy, highlighting the influence of biological rhythms on neurological disorders and the potential for rhythm-based disease prediction and management [3].

AI- and Wearable-Based Digital Sleep and Brain Health Monitoring - Emerging digital health technologies are transforming the assessment and monitoring of sleep and brain health. This lecture introduces multichannel wearable devices, mobile sleep-state analysis, and advanced epidermal biosensors using stretchable dry adhesives for reliable physiological signal acquisition [4,5]. These technologies provide new opportunities for continuous, real-world sleep monitoring and AI-driven personalized assessment of brain health.

Hippocampal Circuitry, Memory, and Epilepsy - Focusing on temporal lobe epilepsy, this section explores structural and functional remodeling of hippocampal circuits, including subregion- and layer-specific synaptic and axon–myelin alterations. It further examines the relationships between distinct hippocampal subfields and specific memory domains [6], as well as the role of the medial entorhinal cortex in modulating hippocampal network dynamics and suppressing seizure-like activity [7]. These findings support a network-based understanding of epilepsy as a disorder involving not only seizures but also memory and cognitive dysfunction [8], opening new avenues for circuit-targeted therapeutic strategies [7].

Sex and Gender Differences in Brain Health and Precision Medicine - This section highlights the importance of considering sex and gender differences in brain structure, function, and disease. Through neuroimaging-based approaches, it examines how biological sex and gender-related factors contribute to individual variability in brain health and neurological disorders [9]. These insights underscore the need to move beyond one-size-fits-all approaches toward sex- and individual-specific strategies for brain health assessment, disease prevention, diagnosis, and treatment [10].

Keywords: Temporal lobe epilepsy, Sleep, Focused Ultrasound, Neuromodulation, Structural-Functional Connectivity, Cognition, Brain Aging

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Biography of Prof. Luke P. Lee

Luke P. Lee is a Professor at POSTECH and Harvard Medical School and Founding Director of K-BIGHEART at POSTECH. He earned his BA in Biophysics and his Ph.D. in Applied Physics and Bioengineering from UC Berkeley, joining the faculty there in 1999 after industry experience. He became the Arnold and Barbara Silverman Distinguished Professor and the Lester John and Lynne Dewar Lloyd Distinguished Professor at Berkeley. He served as Chair Professor in Systems Nanobiology at ETH Zürich. He founded the Biomedical Institute for Global Healthcare Research & Technology (BIGHEART) and served as Associate President for International Research and Innovation and as the Tan Chin Tuan Centennial Professor at the National University of Singapore. He also founded the Institute for Quantum Biophysics at Sungkyunkwan University, Korea. He has authored over 350 research articles and four book chapters and holds 60 patents. He is a Fellow of the Royal Society of Chemistry and the American Institute of Medical and Biological Engineering, and he has received awards including the IEEE William J. Morlock Award, NSF Career Award, Fulbright Scholar Award, and the HoAm Prize.

Nanomedicine via K-BIGHEART

Luke P. Lee

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ABSTRACT

The Korea Biomedical Institute for Global Health Research and Technology (K-BIGHEART) is pioneering a new paradigm in global healthcare by developing innovative **Biomedical Integrated Circuit (BIC)** chips, cultivating creative scientific talent, and serving hearts in need. This presentation outlines K-BIGHEART's strategic vision and its latest breakthroughs across microfluidics, biosensors, extracellular vesicle (EV) detection, and digital health. First, the **Nanoscale Optical Antennas System (NOAS)** advances nanomedical discovery and precision medicine by enabling visualization of quantum-biological electron transfer in living cells, controlled siRNA release, tracking of bacterial EV communication, and ultrafast photonic PCR. Second, we introduce the **Exosome Detection via Ultrafast-Purification System (EXODUS)** for nanomedical diagnostics and therapeutics, as well as **iTEARS**, a platform that analyzes tear exosomes to identify key biomarkers for precise, non-invasive diagnostics. Together, NOAS and EXODUS provide the foundation for an **AI-based Molecular Diagnostic System (AIMDx)**. Third, we report on the **Brain MAP** platform, which integrates microfluidics and EEG to engineer and monitor brain organoids, thereby accelerating research into neuropathogenesis and neurodegenerative therapies through EV-based analysis. Ultimately, these foundational platforms will support **AI-driven Microphysiological Organoid Analysis Systems (AIMOASIS)**. Through convergent sciences and global collaboration, K-BIGHEART aims to advance affordable, personalized healthcare worldwide through precision nanomedicine.