HANYANG-PURDUE JOINT SYMPOSIUM
ON SMART HEALTHCARE TECHNOLOGY

Date. **JULY 11 (FRI) 09:30 ~ 13:00**

Venue. **ITBT 501, Hanyang University**

HYU HANYANG UNIVERSITY SEOUL, KOREA

PURDUE UNIVERSITY

Schedule.

09:30 ~ 09:40 Opening

09:40 ~ 10:05 Prof. Sunghee (Estelle) Park (Purdue University)

Engineering development and disease in human organoids-on-a-chip

10:05 ~ 10:30 Prof. Sungyoung Choi (Hanyang University)

Advancing cell-based diagnostics: from CD4/CD8 Profiling to antigen-Loss Tumor Detection

10:30 ~ 10:55 Prof. Chi Hwan Lee (Purdue University)

Wearable Biomedical Devices for Chronic Disease Management

10:55 ~ 11:20 Prof. Changsoon Choi (Hanyang University)

Fiber based Energy Storage, Harvesters, and Actuator

11:20 ~ 11:45 Prof. Hyowon (Hugh) Lee (Purdue University)

Smart Medical Devices with μSensors and μActuators

11:45 ~ 12:10 Prof. Sunghwan Kim (Hanyang University)

Nanostructuring biomaterials to integrate bio-electronic and photonic functions for smart healthcare

12:10 ~ 12:35 Prof. Young L. Kim (Purdue University)

Spectral vision of colors for mobile health applications

12:35 ~ 13:00 Closing

BK21 융합IT 미래인재양성 연구단

09:40 – 10:05	Sunghee (Estelle) Park	Purdue University

Engineering development and disease in human organoids-on-a-chip

Human organoids offer transformative potential for modeling organ development and disease, yet conventional culture systems often fall short in replicating the physiological complexity and functional maturity of native tissues. To address these limitations, we developed microengineered platforms that expand the utility of organoid technology in biomedical research.
First, we present our gut organoids-on-a-chip, a system designed to optimize nutrient and signaling molecule delivery in 3D organoid cultures. By overcoming the geometrical constraints of conventional drop cultures, our gut chip enables sustained, long-term development of intestinal organoids, significantly enhancing their structural and functional maturity. Using this platform, we generated a patient-derived organoid model of inflammatory bowel disease that faithfully reproduces key pathological features, including epithelial barrier disruption and immune activation. Additionally, our platform enables the generation of vascularized, perfusable enteroids, enhancing the physiological complexity and functionality of organoid models.
Second, we developed a mechanically actuatable organoid-on-a-chip platform to investigate the role of fetal breathing movements (FBMs) in human lung development. Integrating hPSC-derived alveolar organoids with microengineered devices, this system applies physiologically relevant mechanical forces that mimic FBMs observed during late gestation. Our study demonstrates that FBM-induced forces play a significant role in regulating alveolar morphogenesis and epithelial maturation, providing critical insights into the dynamic biomechanical processes underlying the development and functional maturation of the respiratory system.
By integrating dynamic mechanical and biochemical environments, these organoids-on-chips address limitations of conventional organoid culture, enabling more predictable models of human organogenesis and disease.

<Keywords> Tissue engineering; Organoids; Organ-on-a-chip; Microfluidics; Stem cells

- Recipient of the ORAU Ralph E. Powe Junior Faculty Enhancement Award (2025)
- Graduate Women in Science (GWIS) National Fellowship Program Committee (2024-present)
- Member of the Korea Technology Advisory Group (2025-present)
- Recipient of the Solomon R. Pollack Award (2024)

10:05 – 10:30	Sungyoung Choi	Hanyang University

Advancing cell-based diagnostics: from CD4/CD8 Profiling to antigen-Loss Tumor Detection

Precise cellular diagnostics is essential for understanding disease progression and guiding therapeutic decisions, especially in immunological and hematological disorders. As a researcher dedicated to advancing cell-based diagnostic technologies, I present three key diagnostic platforms developed in our lab. First, a portable CD4/CD8 cell counter enables rapid immune profiling for HIV patients in resource-limited settings. Second, a multiplexed rolling circle amplification assay allows simultaneous detection of surface proteins and mRNAs at the single-cell level, enabling identification of CD19 antigen-loss tumor cells in B-ALL. Third, a hyperspectral microflow cytometry system provides high-resolution spectral classification of immune cell subtypes. These approaches aim to enhance diagnostic precision, accessibility, and clinical impact.

<Keywords> Single cell analysis; microfluidics; microflow cytometry; multiomics; cell separation

- Department chair, BME Hanyang University, 2023-
- Associate Editor, Biochip Journal, 2021-2023
- Samsung Science & Technology Foundation, Principal Investigator, 2016-2021
- Young Investigator Award, Korean BioChip Society, 2019

10:30 – 10:55	Chi Hwan Lee	Purdue University

Wearable Biomedical Devices for Chronic Disease Management

My laboratory at Purdue University focuses on bridging the gap between engineering and unmet clinical needs through innovations in wearable technologies. We develop novel yet simple flexible micro-transducers with a clear translational pathway to clinical impact. Our research explores wearable biomedical devices that safely attach to the skin or eye, enabling continuous, remote monitoring of health and chronic diseases with applications in healthcare, rehabilitation, and telemedicine. In this talk, I will present: (1) Sticktronics—sticker-like thin-film electronics attachable to curved surfaces for broader industrial and healthcare use; (2) sensory skin patches designed for urgent clinical needs in telemedicine; (3) smart contact lenses, built on commercial soft lenses, for continuous monitoring of chronic ocular diseases such as glaucoma; and (4) flexible, biodegradable patches embedded with injectable silicon nanoneedles for painless, sustained ocular drug delivery. I will share experimental and theoretical insights across these platforms.

<Keywords> Wearable Biomedical Devices; Stretchable Electronics; Healthcare Technologies

- Fellow of the American Institute for Medical and Biological Engineering (AIMBE)
- Leslie A. Geddes Professor at Purdue University
- University Faculty Scholar at Purdue University
- Recipient of the NIH Trailblazer Award
- Founder of four startups with over 20 patents and technology transfers

10:55 – 11:20	Changsoon Choi	Hanyang University

Fiber based Energy Storage, Harvesters, and Actuator

As the paradigm rapidly shifts from portable electronics to wearable electronic systems, extensive research efforts have been devoted to developing materials and devices tailored for wearable applications. In particular, energy storage and harvesting devices in the form of fibers or textiles have garnered significant attention as key components of next-generation energy technologies, owing to their intimate skin conformability and seamless integration with the human body. This presentation highlights recent advancements in carbon nanotube (CNT)-based fiber electrodes applied to batteries, supercapacitors, and mechano-electrochemical energy harvesting systems. Furthermore, fiber-shaped electrodes have demonstrated potential as artificial muscles that can perform mechanical work, such as rotation or axial contraction, driven by volumetric expansion induced by external stimuli. CNTs are exceptionally well-suited for these diverse wearable device applications due to their intrinsic mechanical flexibility, superior electrical conductivity, and spinnable one-dimensional architecture, making them an ideal electrode material platform for multifunctional wearable technologies.

<Keywords> CNT, Yarn, Supercapacitor, Energy Harvester, Artificial Muscle

- Selected for the Presidential Postdoctoral Fellowship

11:20 – 11:45	Hyowon (Hugh) Lee	Purdue University

Smart Medical Devices with μSensors and μActuators

The development of chronically reliable and multifunctional implantable medical devices is an enormous challenge in biomedical engineering with significant economic and clinical implications. Soon after implantation, implants often suffer from substantial performance degradation and premature failures due to various abiotic and biotic failure modes. Enabling technologies that improve the lifetime of these implantable devices can have an enormous impact on many debilitating chronic neurodegenerative diseases that are difficult to diagnose and treat. In this presentation, I will discuss our latest efforts to utilize thin-film-based microscale sensors and actuators to fabricate self-clearing implantable medical devices for chronic disease management. As a proof-of-concept, I will share our efforts to create chronically implantable self-clearing catheters, and novel peripheral nerve interface, and a closed-loop opioid overdose sensing and treatment device.

<Keywords> Implantable microsystems, human-machine interface, neuroengineering, opioid use disorder

- Director of Center for Implantable Devices, 2021
- Chair, Indiana Clinical and Translational Sciences Institute Device Think Tank, 2023
- Program Manager, ARPA-H, 2025

11:45 – 12:10	Sunghwan Kim	Hanyang University

Nanostructuring biomaterials to integrate bio-electronic and photonic functions for smart healthcare

Integrating electronic and photonic functions into biological tissues has been an attractive area in biomedical engineering, as it opens new avenues for smart diagnostics and therapies with real-time operation and high accuracy. However, establishing a seamless interface between abiotic devices and biotic systems remains challenging due to inherent mechanical, chemical, and biological mismatches. Here, I present recent research that addresses these abiotic–biotic interface issues. To ensure the biocompatibility of all functional devices, silk protein extracted from Bombyx mori cocoons is utilized as the primary matrix material. The central challenge lies in incorporating electronic and photonic functions with performance levels comparable to those of conventional rigid, dielectric-based devices. To realize ultrathin skin electronics, silk protein was electrospun into nanofibers. By integrating conductive nanomaterials, we fabricated ultrathin, skin-conformal electronic patches capable of monitoring biosignals on the skin and delivering drugs transdermally. Furthermore, electron-beam irradiation of the silk enables 2.5D nanostructuring through a fully water-based process, allowing integration of nanophotonic capabilities. This approach provides a new platform for controlling electronic and photonic signals directly on biological tissues.

<Keywords> Silk protein, nanophotonics, electronic tattoo, abiotic-biotic interface, nanostructuring

- TJ Park (Cheongam) Science Fellow
- Secretary of the Lithography Division in the Optical Society of Korea
- Fellow of the Optical Society of Korea
- Committee Member of the Next Generation Lithography Conference
- Secretary of the Korean Society of Sericultural Science

12:10 – 12:35	Young L. Kim	Purdue University

Spectral vision of colors for mobile health applications

My current research focuses on spectral vision - machine reading and learning of color to address large-scale health challenges. Recent advances in computer vision for biomedical imaging have primarily emphasized spatial analysis and feature extraction, overlooking the rich diagnostic information conveyed by intrinsic color. This gap underscores a critical need for developing machine learning frameworks that explicitly model color in biomedical contexts. We introduce hybrid machine learning for spectral vision capable of extracting high-resolution spectral information from smartphone photographs. Our approaches integrate principles from optical spectroscopy, color science, and machine learning to enable noninvasive diagnostics. This biologically and physically informed strategy reduces hardware complexity while enhancing interpretability, setting it apart from conventional, purely data-driven learning approaches. Our ongoing mobile health (mHealth) research in sub-Saharan Africa, including Kenya and Rwanda exemplifies reciprocal innovation, where mHealth technologies developed for resource-limited settings are adapted for use in the US. Overall, spectral vision-powered mHealth technologies offer mobility, simplicity, and affordability, enabling rapid and scalable adoption across diverse digital health applications.

<Keywords> Machine learning, hybrid machine learning, color vision, spectral vision, mobile health, global health

- Virtual Lab Director, Korea Research Institute of Standards and Science, 2020
- First Prize Winner of National Institutes of Health (NIH) Technology Accelerator Challenge, 2020
- University Faculty Scholar, Purdue University, 2021 -
- Showalter Faculty Scholar, Ralph W. and Grace M. Showalter Research Trust, 2022
- Health Scientist, Centers for Disease Control and Prevention (CDC), 2022 -