

第四回 ナノ生物流体工学セミナー

日時 : 9 月 19 日, 11:00 am-12:00 pm

場所: Conference Room (134) 1st floor, Bldg No.1 of LiMe

<https://www.infront.kyoto-u.ac.jp/en/access/>

Research Introduction & Overview of the Strategic direction for the Global R&D projects

Min-Ho Lee

School of Integrative Engineering, Chung-Ang University
84 Heukseok-ro, Dongjak-gu, 06974,
Republic of Korea

*Email : mhlee7@cau.ac.kr

Abstract

In this presentation, I will discuss the results obtained from our work on electrochemical biosensors. Specifically, I will highlight the development of a duplex biosensing platform for the quantitative detection of biomarkers, where we utilized highly conductive nanomaterials in combination with customized electrodes. One of our key findings includes the modification of electrodes using transition metal dichalcogenides (TMDs) or graphene heterostructures. These developed sensors demonstrated enhanced sensitivity and selectivity, showing excellent correlation with commercially available standard methods.

For the multiplexed and sensitive detection of miRNAs in diagnostic applications, we introduced an innovative strategy combining MXene-based electrochemical signal amplification with a duplex-specific nuclease (DSN)-based system. This approach enabled rapid, attomolar-level, simultaneous quantification of multiple miRNAs on a single platform in real samples.

Additionally, to further improve sensitivity for detecting low levels of miRNAs, we developed a novel method called ‘relay-race amplification.’ This technique synergistically combines a 3-way junction structure with signal amplification using gold nanoparticles conjugated with multiple signaling labels.

Following the presentation of my research, I will briefly introduce the direction and objectives of a global R&D project being promoted by the Korea Office of Science and Technology Innovation. This initiative aims to establish collaborative research centers within leading global research institutes and universities, with the goal of advancing cutting-edge research in promising technology areas. Specifically, I will discuss the plans for promoting joint research in the advanced biotechnology field and outline the strategies being implemented to facilitate these collaborative efforts.

Keywords: *Electrochemical method, multiplex biosensor, RNA detection, immunoassay*

References

- [1] M. Mohammadniaei, et al., "Relay-race RNA/barcode gold nanoflower hybrid for wide and sensitive detection of microRNA in total patient serum", 2019, *Biosensors and Bioelectronics*, **141**, 111468
- [2] L. Kashefi-Kheyraadi, et al. "A MoS₂@ Ti₃C₂Tx MXene hybrid-based electrochemical aptasensor (MEA) for sensitive and rapid detection of Thyroxine", 2021, *Bioelectrochemistry*, **137**, 107674
- [3] HU Kim, et al. "Concurrent and Selective Determination of Dopamine and Serotonin with Flexible WS₂/Graphene/Polyimide Electrode Using Cold Plasma" *Small*, 2021, **45**, 2102757
- [4] L. Kashefi-Kheyraadi, et al, "Rapid, multiplexed, and nucleic acid amplification-free detection of SARS-CoV-2 RNA using an electrochemical biosensor" 2021, *Biosensors and Bioelectronics*. **195**, 113649

Biography

Min-Ho Lee is a professor in the School of Integrative Engineering at Chung-Ang University, where he has been a faculty member since 2017. He earned his Ph.D. in Bioengineering from Rice University in 2006. From 2006 to 2017, he served as a Team Leader and Managerial Researcher at the Korea Electronics Technology Institute, where he contributed to the development of various medical devices and diagnostic systems, including lateral flow assays (LFA) and polymerase chain reaction (PCR) devices. His research primarily focuses on the development of advanced biosensors. At Chung-Ang University, he collaborates with several diagnostic companies to create highly sensitive sensors. He has authored over 120 publications in leading journals, including *Biosensors and Bioelectronics*, *Small*, and *Analytical Chemistry*.