令和６年度奨励会外国人研究者講演会

学術変革Bスケール横断分析セミナー

第 69 回「工学とバイオ」セミナー/ MMCもしかする未来の化学

Sensors, Sample Preparation, and Fluidic Manipulation

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Date: Oct. 29, 2024 (16:00~17:00)

Place: IIS, Fw701 / 702

Abstract :

In this presentation, I will discuss the work done in my group on a type of optical sensors called leaky waveguides (LWs).

I will discuss their applications for measurement of ferritin and its average iron content, which can be used for early identification of high-risk trauma patients. LWs are universal sensors and hence we have been working to extend their applications to a range of protein biomarkers (e.g., vascular endothelial growth factors, lactoferrin), DNA, and small molecules. I will then discuss integration of LW sensors with electrokinetic sample manipulation for reducing analysis time, microfluidic gradient generator for simultaneous quantification and calibration and integration with complementary electrochemical methods.

Subsequently, I will discuss our research on hydrogels for concentration, fluorescent labelling, and light-triggered release of proteins followed by their detection. Currently, our hydrogel can measure proteins with a limit of detection of 0.003 ppm or 53 pM for an exemplar analyte, streptavidin, while being less laborious than the state-of-the-art method, enzyme-linked immunosorbent assay. Equally, we have shown that the presence of high molecular weight interferents such as mucin at 100- and 1000-times higher concentrations than the exemplar analyte did not influence protein measurement. Our aim is to use our hydrogels to make lozenges and lollipops for concentration and labelling of salivary biomarkers for detection of oral cancer.

Finally, I will discuss an upcoming research direction in my group on fluidic manipulation using acoustics. I will describe our studies on an oscillatory chemical reaction (Belousov–Zhabotinsky (BZ) reaction) and a bioassay (fluorescein diacetate (FDA) and esterase enzyme assay) in acoustically levitated droplets. We have also shown that it is possible to perform multiple simultaneous reactions with good reproducibility and repeatability, thus opening the possibility of using acoustic levitation for parallelised experimentation. In addition, the solution volume used in the levitator was 4 µL compared to 3 mL in vials, a reduction by a factor of 750, making this method well suited for experimentation with high-cost materials.

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