

Fly Olfactory Mimetic Peptide Functionalized Graphene Field Effect Transistor for Volatile Organic Compound Sensing

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派遣先 ACS FALL 2023 Harnessing the power of Data
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博士課程後期3年 Rungreungthanapol Tharatorn

海外における研究活動状況

研究目的

The ACS Fall 2023 conference was organized by the American Chemical Society (ACS), one of the global pioneer scientific societies in the field of chemistry. The conference enabled the presentations and discussions regarding the recent advancements across various field of chemical science and technology. The purpose of the presentation in this conference is to introduce the novel volatile organic compounds detection system, using insect olfactory mimetic peptide modified graphene field effect transistor which can replicate the sensitive and specific odor recognition ability from living creatures into a sensor platform that we have developed, and to have discussions with the field leading researchers.

海外における研究活動報告

The Murata Science Foundation's support allowed me to participate and present my research in the ACS Fall 2023 conference in San Francisco, USA, hosted by American Chemical Society (ACS). This event was one of the most well-known conferences

in chemistry field where over 10,000 attendees and leading researchers in chemical science and technology gather to share and engage in discussion on their latest findings.

This conference's main theme centered on utilization of artificial intelligent (AI) and machine learning to effectively manage vast amount of experimental data for maximum value. I attended several lectures on machine learning, which will be greatly beneficial for my work on developing an electronic nose. Additionally, lectures covering analytical techniques like gas chromatography and nuclear magnetic resonance proved highly valuable and inspired me to incorporate these newly found technical advancements into my own research for improved volatile compound analysis. During the conference, I made a presentation in the division of Analytical Chemistry Poster session: Title ANYL 3900989: Fly olfactory mimetic peptide functionalized graphene field effect transistor for volatile organic compound sensing on August 16, 2023. This opportunity allowed me to introduce my work to a diverse audience of researchers from various backgrounds, leading to thought-provoking discussions and questions I had

not previously considered.

During a two-hour poster session, I presented a novel volatile organic compounds (VOCs) detection system utilizing fruit fly's olfactory receptor (OR) mimetic peptide modified on the graphene field effect transistor (GFET) sensor. These compounds are commonly found in the environment and employed as biomarkers in diverse detection applications, thus being able to accurately monitor and detect them is crucial. In nature, animals and insects rely on their biological olfactory systems, which incorporate ORs, to precisely detect VOCs to ensure their survival. I pursued an alternative approach by developing peptide recognition probes derived from the ORs to mimic the VOC-binding ability which offer a more convenient usage. To achieve this, a peptide screening technique by using OR-derived peptide array library and gas chromatography-mass spectrometry was developed. Thorough examination of the entire OR protein revealed the potential mechanism behind VOC-binding and identified the essential part responsible for VOC recognition, which was then synthesized as a short peptide probe. This peptide probe was then functionalized on GFET to overcome the selectivity limitation of the conventional GFET sensors. The resulting OR-mimetic peptide modified GFET sensor displayed excellent sensitivity and detection limit at picomolar levels (ppt level) in detecting target VOCs with exceptional

specificity. From the result, VOCs binding ability from OR was successfully miniaturized into small peptide probe. This peptide screening technique offers adaptability for diverse target-specific peptide from various established OR-VOC pairs. As such, the peptide-GFET approach demonstrated here can be employed as a versatile VOC sensor for on-field odorant sensing and provide the fundamentals for the development of future VOC detection systems.

During the poster presentation, I received questions concerning the peptides' ability to replicate OR function, despite their small size relative to the OR. This prompted a discussion about the possibility of a three-dimensional VOC binding pocket inside the OR and led me to consider conducting future experiment to compare the sensing performance between the original OR and the peptide derived from it. Furthermore, I engaged in discussions with fellow researchers who are also working on the development of VOC detection using different techniques such as solid-phase microextraction GC-MS (SPME-GC-MS). This interaction highlighted the potential divergence in the source of our VOC targets and suggested the promising alternative applications for our detection technique.

この派遣の研究成果等を発表した
著書、論文、報告書の書名・講演題目

Fly olfactory mimetic peptide functionalized graphene field effect transistor for volatile organic compound sensing