

ANALYTICAL SEMINAR

Recent Advances in Microfluidic Sensors using Electromembrane Extraction

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Electromembrane extraction (EME) on microfluidic devices represents a powerful approach for efficient and miniaturized sample preparation. By integrating EME with microfluidic platforms, analytes can be selectively extracted across a supported liquid membrane under an applied electric field, enabling rapid, low-volume, and high-efficiency separation. These devices enhance mass transfer, reduce solvent consumption, and offer excellent clean-up for complex matrices. Recent advancements include the combination of EME with other microextraction techniques, such as thin-film solid phase microextraction (TF-SPME) and microfluidic paper-based analytical devices (μ PADs), further improving sensitivity and selectivity. The adaptability of microfluidic-EME systems makes them ideal for on-site and portable analysis in environmental, biological, and food safety applications.



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Microsphere-Assisted Super-Resolution Microscopy

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Microspheres made of dielectric materials can act as magnifying lenses. Unlike conventional geometric optics lenses, these microspheres exhibit curvilinear light trajectories, resulting in exceptionally short near-field focal lengths. This enables near-field magnification capable of resolving features beyond the diffraction limit. The combination of microspheres with traditional optical microscopes can turn them into super-resolution microscopes. This has several advantages including low cost, simple operation, and label-free, real time dynamic imaging via white light with higher resolution. Microsphere-assisted microscopy, which emerged in the past decade, has proved to be a simple yet efficient technique to increase imaging resolution. For example, coupling microsphere-assisted microscopes with self-scanning cantilevers allowed large-scale fast-reading imaging for 2D samples and exhibited better scanning robustness than previously reported scanning imaging methods. Recent advancements using microsphere-assisted microscopy have shown applicability across multiple fields like nanodevices, biomedicine and semiconductors.



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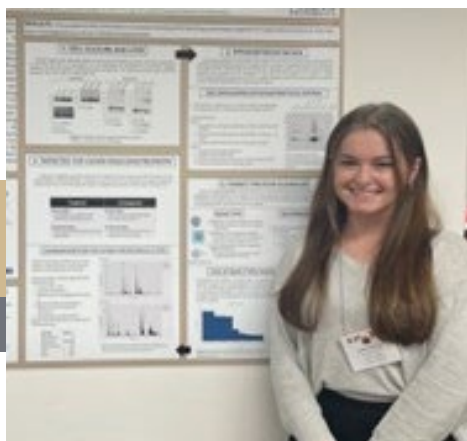
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ANALYTICAL SEMINAR

Using Mediated Electrochemical Probing to Profile Redox Properties of Complex Biopolymers

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It is essential to determine the redox reactions involving many biological analytes for many applications, such as quality control for drug development, understanding the cause of diseases, and characterizing drug-target interactions. Mediated electrochemical probing (MEP) is an emerging analytical technique that can study these redox reactions in real time, nondestructively, and whose results can be analyzed to produce extensive information to support these endeavors. This technique has been successfully tested and validated on antibody surface structures, where researchers utilized MEP to observe the presence of reduced cysteine disulfide bonds and the oxidation of methionine residues in a quick and sensitive manner, for quality control use in the biomanufacturing industry. In addition, MEP has been used to characterize the redox properties of several different melanin compounds, including neuromelanin samples and their redox reactions with drugs such as acetaminophen. These applications of MEP have demonstrated its potential to have a strong impact on the field of biology regarding redox reactions.



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