International Institute for Biosensing: 2023 Awardees

The International Institute for Biosensing provides support for the development of a globally engaged institute at the University of Minnesota focused on advancing biosensing research.

Questions? Contact Us:
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Enhanced Fluorescence Biosensensing by Non-Linear Signal Amplification

PI: Elias Puchner, Physics and Astronomy
Co-I: Douglas G. Mashek, Molecular and Cellular Biology

Fluorescent biosensors are gaining popularity due to their versatile applications in vitro and inside living cells to report a myriad of parameters. Elias Puchner's lab in the School of Physics and Astronomy develops improved single molecule and super-resolution microscopy techniques to visualize such biosensors with increased sensitivity and spatial resolution. With support from the International Institute for Biosensing award, they will characterize their recently discovered mechanism of imaging ground state dimers to detect BODIPY-based biosensors with single molecule sensitivity and ~30 nm spatial resolution. The efforts to make this approach universally applicable would strongly increase the sensitivity of existing biosensors and expand the toolbox to study biological processes in cells at the nanometer length scale.

Holographic Biosensor for Airborne Infection Control in Dental Clinics

PI: Jiarong Hong, Mechanical Engineering
Co-I: Paul James Jardine, Diagnostic and Biological Sciences

An interdisciplinary team of engineers, virologists, and clinicians from the University of Minnesota is developing a low-cost and compact imaging sensor to monitor potentially infectious particles generated during dental procedures in real time. The sensor uses cutting-edge multi-spectral holographic imaging technology and deep learning to assess infection risks to patients and the clinical team. The technology has broad applications, including controlling infection risk in surgical rooms and ensuring the sterility of liquid samples in food, beverage, and pharmaceutical industries.

Real-Time, Continuous Ion Monitoring for Emergency Medicine Using a Wearable Microneedle Patch

PI: Sarah Swisher, Electrical and Computer Engineering
Co-Is: Philippe Buhlmann, Chemistry; Andreas Stein, Chemistry; Elizabeth Lusczek, Surgery; Eric Wise, Surgery

This project aims to develop and validate a flexible, wearable patch-type sensor for real-time, continuous analysis of clinically consequential biomarkers in interstitial fluid (ISF). It addresses critical limitations in blood analysis for emergency medical diagnosis and triage. In contrast to current single-point measurements, this technology offers less invasive, continuous analysis using a low-cost, easy-to-use wearable patch.

Selective Detection of Chiral Pesticides with Plasmonic Metasurfaces Using Surface-Enhanced Raman Spectroscopy

PI: Vivian Ferry, Chemical Engineering and Materials Science
Co-Is: Christy Haynes, Chemistry; Ping Wang, Bioproducts and Biosystems Engineering

This collaborative project aims to develop a new sensing platform that will detect and differentiate chiral pesticides. The project will detect and distinguish enantiomers using a combination of surface-enhanced Raman spectroscopy and designer, plasmonic nanostructured surfaces, combined with affinity agents to capture the analytes.

Using Light-Sheet Microscopy and FRET-Based Talin Force Sensors to Investigate Dynamic Cell Force Generation

PI: Robert Tranquillo, Biomedical Engineering
Co-I: Meghan K. Driscoll, Pharmacology

Cells are quintessential integrated biosensors, exemplified by cell contact guidance, wherein cells sense aligned fibers by dynamic extension and retraction of cellular processes (pseudopods), a phenomenon both ubiquitous and poorly understood. This project will test the hypothesis that contact guidance results from force-based sensing of stiffness anisotropy in aligned fiber networks by pseudopods extending along and against the fiber direction. To do so, we will combine high-resolution fluorescent light-sheet microscopy and analysis from the Driscoll lab with magnetically-aligned photo-crosslinked fibrin gels from the Tranquillo lab using fibroblasts expressing FRET-based talin sensors provided by Martin Schwartz (Yale) in order to elucidate the relationship between the spatiotemporal pattern of force generation in “competing pseudopods” and cell orientation (contact guidance) in aligned fibrin gels of varied stiffness anisotropy.