MAE Seminar Series

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Zoom Information
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CONNECTING THE DOTS—CAPTURING AND DETECTING LOW CONCENTRATION PATHOGENS IN BODILY FLUIDS

ABSTRACT

The ongoing COVID-19 pandemic is unprecedented and a striking indicator of the fact that the global community is struggling to prevent epidemics caused by infectious diseases. Since the development of vaccines can take a long time, rapid testing followed by isolation is the most efficient way to control current and future epidemics. However, gold standard molecular methods of diagnosis based on nucleic acid amplification are time consuming and rely on delicate reagents and instruments. In addition, capturing and amplifying pathogen nucleic acids in bodily fluids is extremely challenging with the presence of a high background of human DNA. Therefore, an ideal, next generation molecular diagnosis scheme requires efficient pathogen extraction from bodily fluids, accurate target recognition and labeling, and sensitive instruments for reading the target signal. In this talk we will unfold our progress towards these goals by explaining a computational fluidic dynamics and optical tomography optimized nano-sieve device for the rapid isolation of drug-resistant bacteria from whole blood. The nano-sieve is deformable and can be used to concentrate and retrieve pathogens from the device which is the key for lysis-free and amplification-free detection. We will then introduce our work on Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR), an emerging technology for rapid, sensitive, and isothermal pathogen diagnosis. Ultra-bright quantum dots are conjugated with the CRISPR Cas12a assay, enabling a portable and power free Funnel Adapted Sensing Tube (FAST) chip, intended for simple self-diagnosis. We will finish by introducing our efforts to extend this assay to a fully Integrated Micropillar Polydimethylsiloxane Accurate CRISPR detection (IMPACT) system, enabled by ultra-high aspect ratio silicon nanowire arrays.

BIO SKETCH

Professor Du is currently a tenure-track assistant professor of mechanical engineering at the Rochester Institute of Technology (RIT) and leads the Nanobiosensing, Nanomanufacturing, and Nanomaterials (3N) Lab. He also holds appointments in the microsystems engineering and school of chemistry and materials science. Before joining RIT in 2018, he was a postdoctoral researcher in the chemistry department at the University of California-Berkeley. Currently, Du's research group at RIT has been studying the interactions between biomolecules and nanostructures at the single-molecule level to enhance biomarker trapping and sensing. His group has published papers in journals such as ACS Applied Materials & Interfaces, Advanced Functional Materials, ACS Sensors, Biosensors and Bioelectronics, Electrophoresis, and Nanotechnology and has been widely covered by popular media including Science Daily, Yahoo Finance, The Science Times, and EurekAlert. Du has been recognized as one of the twenty five global rising stars in sensing by ACS Sensors, a special issue celebrating early stage investigators. He has also been the recipient of the Burroughs Wellcome Fund (BWF) Collaborative Travel Grant (2019), the National Science Foundation (NSF) Graduate Student Fellowship (2012), James H. Potter Award (2014), and Innovation & Entrepreneur (IE) Fellowship (2009–2014). He was the only recipient worldwide of the 2017 Biosensors Travel Award and one of only two recipients worldwide of the 2017 Micromachines Travel Award.