Chemistry Departmental Colloquium

Thursday, December 7, 2023
4:30 p.m. ~ WTHR 104

"Advancing Point of Care Diagnostics Using Capillary Flow Microfluidics"

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BIO: Dr. Charles Henry is a Professor of Chemistry, Chemical & Biological Engineering, and Biomedical Engineering at Colorado State University and an adjunct Professor in the Metallurgy and Materials Science Research Institute at Chulalongkorn University in Thailand. He also serves as CEO for Burst Diagnostics, Inc. He received his Ph.D. in Analytical Chemistry under the supervision of Dr. Ingrid Fritsch at the University of Arkansas and was an NIH postdoctoral fellow at the University of Kansas under the supervision of Dr. Susan Lunte. His research interests lie broadly in the areas of microfluidics, electrochemistry, and sensors with application to questions in bioanalytical and environmental chemistry. Dr. Henry was the recipient of the inaugural ACS Measurement Science award in 2019 and was named Professor Laureate by the College of Natural Sciences at CSU. Dr. Henry has helped found multiple startup companies and is an associate editor for Analytica Chimica Acta.

Abstract:

Point-of-care (POC) technologies have been a useful tool in medical and environmental diagnostics for decades with the handheld glucometer as a leading example. The COVID-19 pandemic further pushed POC technologies to the forefront of many people's thinking as a critical tool in the fight against the disease. In addition, the pandemic has expanded the opportunities for using these tools as important tools outside of just human health applications. However, a major conundrum in many POC diagnostics has been the tradeoff between assay performance (sensitivity, specificity, LOD, etc) and ease of use. The simplest diagnostics require 1-2 user steps to achieve a result but lack the ability to detect low analyte levels. An example of this is the recent development of rapid antigen tests for COVID-19 that only provide useful results for individuals with high viral loads. Increasing sensitivity to make tests useful at lower viral loads would necessitate either added user steps or a significant increase in cost. Microfluidic Paper-based Analytical Devices (mPADs) have received significant attention as a tool to address current shortcomings in both medical and environmental diagnostics because they are inexpensive, easy to use, and can perform a wide range of chemical and biochemical assays. mPADs are normally made from porous hydrophilic materials patterned with hydrophobic materials to create flow barriers to direct flow from a sample inlet through sample pretreatment zones to a detection zone. Furthermore, functional elements like electrodes can be easily integrated, improving functionality, sensitivity, and selectivity. Despite their advantages, mPADs are frequently limited to long analysis times (10s of minutes) due to slow capillary flow and poor limits of detection due to an inability to amplify signal. Our group has recently reported capillary-flow driven microfluidic devices that use channels formed using laser patterning in polyester films and double-sided adhesive combined with paper-based pumps and reagent storage systems to enhance the performance of mPADs. We refer to these devices as fast-flow microfluidic devices. This talk will focus on both traditional mPADs as well as newer fast-flow devices for point-of-need diagnostics with applications in both clinical and environmental diagnostics.

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