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SEMINAR SERIES

Wednesday, February 28th, 2024
Seminar Presentation: 11:00am – 12:00pm
SME room 248

"Integrated 3D Printed Microfluidic Systems for Bioanalysis"

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Abstract: 3D printing offers exceptional capabilities for the creation of miniaturized systems to study biomolecules. My research focuses on the development and utilization of 3D printers that can form integrated microfluidic systems to carry out various bioanalysis functions. We have used 3D printing to create microfluidic channels, pumps, and valves that can carry out a host of bio-relevant applications, including serial dilution [1], electrophoresis [2-3], affinity extraction [4-5], and solid-phase extraction with fluorescence labeling [6]. We have utilized these microfluidic systems in the determination of maternal serum protein and peptide biomarkers linked to the risk of a preterm birth (PTB) [2-4,6]. We have also detected RNA linked to mosquito-borne viruses in 3D printed microfluidic systems [5]. We are now automating fluid delivery using on-chip pumps and valves [1-2] to streamline and simplify assays, and to enable integration of sample preparation processes in these microdevices [7]. Our strategy provides lower detection limits, reduced dead volume, and simplified analysis protocols, enhancing analysis capabilities and outcomes. Finally, our initial demonstrations of integrated microscale 3D printed fluidic systems offer excellent potential for future applications in a wide array of bioanalytical diagnostics.

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References:

[1] J.L. Sanchez Noriega et al. Spatially and optically tailored 3D printing for highly miniaturized and integrated microfluidics. Nat. Comm. 2021, 12, 5509.
[2] J.E. Esene et al., 3D Printed Microfluidic Device for Automated, Pressure-driven, Valve-injected Microchip Electrophoresis of Preterm Birth Biomarkers. Microchim. Acta. 2022, 189, 204.
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[4] H.M. Almughamsi et al. Immunoaffinity Monoliths for Multiplexed Extraction of Preterm Birth Biomarkers from Human Blood Serum in 3D Printed Microfluidic Devices. Analyst 2022, 147, 734.
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[6] A.V. Bickham et al. 3D Printed Microfluidic Devices for Solid-Phase Extraction and On-Chip Fluorescent Labeling of Preterm Birth Risk Biomarkers. Anal. Chem. 2020, 92, 12322.
[7] J.E. Esene et al. 3D Printed Microfluidic Devices for Integrated Solid-Phase Extraction and Microchip Electrophoresis of Preterm Birth Biomarkers. submitted 2023.

Biosketch: Adam Woolley has been on the faculty at Brigham Young University (BYU) in the Department of Chemistry and Biochemistry since 2000. He is currently University Professor and Dean of Graduate Studies at BYU. Prof. Woolley received a B.S. degree in chemistry from BYU, a PhD in chemistry from the University of California-Berkeley and he was a Runyon-Winchell Postdoctoral Fellow in the Chemistry and Chemical Biology Department at Harvard University. Dr. Woolley's scholarship is directed at the interface between miniaturization and biomolecules. He develops microfluidic devices for chemical analysis with an emphasis on biomedically relevant assays, and he is utilizing biomolecules to self-assemble nanoscale electronic systems. His research has been funded by the NIH, NSF, Department of Defense, and other private and government funding entities.