School of Molecular Sciences
Arizona State University

SMS Spring 2023 Seminar Series

Friday Apr 21 | 3pm | Biodesign Auditorium

Ion exchange, desalting and salting in nanoliter-scale water-in-oil droplets

Droplet-based techniques have had a profound impact in chemistry, owing to an ability to perform rapid and massively parallel reactions in minute fluid volumes. In many applications, concentration enrichment is required to increase the speed of reactions or the sensitivity of assays; but in-droplet concentration enrichment remains challenging. This talk will focus on recent developments in the Anand laboratory aimed at controlling droplet composition. We recently interfaced electrokinetic concentration polarization with droplet microfluidics to accomplish in-droplet de-mixing. This result is significant because the concentration of any charged species in the droplet can be enriched and the approach can be readily integrated into existing droplet workflows. We also demonstrated electrokinetic separation of two anionic fluorophores within droplets. Such a capability potentiates the droplet-templated synthesis of particles with gradient composition and the development of mobility-shift assays, which rely on discrimination of multiple species tagged with a single-color fluorophore. Finally, by using a calcium-binding dye as an indicator, we verified in-droplet cation exchange. This demonstration of cation exchange in droplets is significant because of its broad applicability to strategies for synthesis and bioassays. These results laid the foundation for new advanced droplet techniques with transformative applications. In this presentation, these techniques are leveraged to enhance the sensitivity and speed of an enzymatic assay of droplet-encapsulated cells. These results are important because they underscore the potential impact of ion exchange on droplet biotechnologies. Finally, we describe preliminary results for the desalting and salting of water-in-oil droplets. This quantitative study of the injection and ejection of ionic species provides a roadmap to implement this technique for a wide range of high-impact applications in droplet microfluidics.

Robbyn Anand, PhD

Associate Professor, Iowa State University

Robbyn K. Anand is the Suresh Faculty Fellow and Carlyle G. Caldwell Endowed Chair in Chemistry at Iowa State University where she joined the Department of Chemistry as an Assistant Professor in August 2015. She earned her Ph.D. in 2010 from the University of Texas at Austin under the guidance of Prof. Richard M. Crooks with the support of an NSF Graduate Research Fellowship. She developed microfluidic devices employing bipolar electrodes for electrokinetic focusing of charged species. Then, as an NIH Postdoctoral Fellow, she worked with Prof. Daniel T. Chiu at the University of Washington on the capture and analysis of circulating tumor cells. At Iowa State, her group has developed methods for circulating tumor cell analysis, electrokinetic enrichment and separation of chemical species within water-in-oil droplets, and more sensitive bioanalysis at arrays of wireless bipolar electrodes. During this time, Prof. Anand also founded the Midwest Retreat for Diversity in Chemistry - an annual event aimed at the retention of underrepresented groups in the chemical enterprise.

**ZOOM option available: https://asu.zoom.us/j/89234740626*