ANALYTICAL SEMINAR

Making Waves: Digital Acoustofluidic Device Permits Rewritable Fluid Pathways

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Microfluidics involves the manipulation of small fluid volumes within miniaturized devices and has broad applications in chemistry, like detection, separations, synthesis, and sample preparation. Its well-known advantages include enhanced safety, reduced cost, a smaller environmental footprint, accelerated reaction rates, and, in some cases, portability. However, notable limitations arise when handling viscous or sticky analytes such as blood, as well as from fixed channel architectures and the risk of contamination.

Digital acoustofluidic devices overcome these challenges by using surface acoustic waves to manipulate droplets or solid samples in a variety of pathways. By dispensing droplets atop an inert oil layer rather than directly on the device surface, contamination and surface adsorption are minimized, enabling device reuse across multiple reactions. This approach also facilitates the processing of viscous or previously incompatible biomolecules. Consequently, digital acoustofluidic systems hold significant promise for biomedical applications such as automated enzymatic reactions, SELEX screening, DNA/RNA sample preparation, drug testing, and chemical synthesis.

Tuesday, October 28, 2025 | 3:30 pm | WTHR 172

PURDUE UNIVERSITY | James Tarpo Jr. and Margaret Tarpo Department of Chemistry

ANALYTICAL SEMINAR

Mass Cytometry (CyTOF): High-dimensional analysis of single cells

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Quantitative identification of cellular phenotypes within heterogeneous populations requires simultaneous measurement of many biomarkers in individual cells. Conventional fluorescence-based flow cytometry is limited by spectral overlap to about a dozen parameters, while spectral flow cytometry extends this to roughly forty through spectral unmixing. Mass cytometry replaces fluorophores with metal isotope tags detected by inductively coupled plasma time-of-flight mass spectrometry, theoretically enabling up to 135 parameters, though practical analyses are limited to about sixty by isotope availability and antibody chemistry. This seminar will cover the foundational principles, current applications, and future directions of mass cytometry for high-dimensional, targeted analysis of cells and tissues.

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ANALYTICAL SEMINAR

Exploring dynamic interfacial chemistry of single nanoparticles through the eyes of Plasmonic Scattering Interferometric Microscopy (PSIM)

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Detection and imaging of single nanoparticles, as well as real time measurement of change during electrochemical reactions allows for understanding the structure performance relationship of nanomaterials and for diverse applications ranging from studying electrocatalysis reactions to label free detection of biomolecules. To overcome the inherent intensity limitations of optical imaging techniques as well as achieving high throughput and real time measurements, plasmonic scattering interferometric microscopy (PSIM) was developed. Introduction of a interferometric phase parameter (ψ) allow for quantitative measurement of dynamic interfacial change over a single nanoparticle with high spatiotemporal resolution, diverse class of nanoparticles and mild solution conditions. Imaging quality was significantly improved (67-fold) through development of high resolution plasmonic scattering interferometric microscopy (HR-PSIM). Electrocatalytic activity and reaction kinetics study at single particle level was achieved. Novel algorithmic methods were incorporated to remove background interference and process automation for high throughput studies. A pixel-wise reaction times estimation method and mitigating focus drift hold the potential for further improvement in resolution and image accuracy.

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