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3:45 PM
RNS 390

CHEMISTRY SEMINAR

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Parallel Selective Capture of Single Circulating Melanoma Cells and Functional Analysis

Understanding and measuring cell-to-cell variation is critical for addressing many unmet needs in human health. A small subset of cells with distinct phenotypes can drive both normal physiology and disease. Yet, current single-cell platforms are constrained by the limited number and type of endpoints they can measure. This challenge is compounded in clinical samples, which contain mixed cell populations, and where isolation methods often compromise cell viability and function. As a result, the ability to assess native processes such as signaling, drug response, or cell-cell interactions is severely restricted. To overcome these limitations, we have developed a unified platform that enables integrated selection, fluidic isolation, optional lysis, and parallel single-cell assays while preserving cell viability and phenotype. The system captures cells by dielectrophoresis (DEP) at arrays of wireless bipolar electrodes (BPEs) aligned to picoliter chambers. We demonstrate its selectivity through isolation of circulating melanoma cells (CMCs), which evade conventional marker-based methods. Building on this DEP-BPE foundation, we present three key advancements: (1) a single-cell protease secretion assay quantifying MMP9 linked to invasiveness; (2) use of BPEs as electrochemical sensors and as substrates for in situ electropolymerization; and (3) an insulator DEP (iDEP) configuration that prevents cell-electrode contact, enhancing viability. Finally, we show discrimination of melanoma cells resistant to chemotherapeutic agents. In concert, these methods enable parallel isolation of viable single cells and collection of functional information, providing insights that can inform clinical decision-making and personalized treatment strategies.

About the Speaker

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 in August 2015. Her group has developed methods for circulating tumor cell analysis, electrokinetic enrichment and separation of chemical species within water-in-oil droplets, and label-free sensors based on surface conduction of ions.