Research

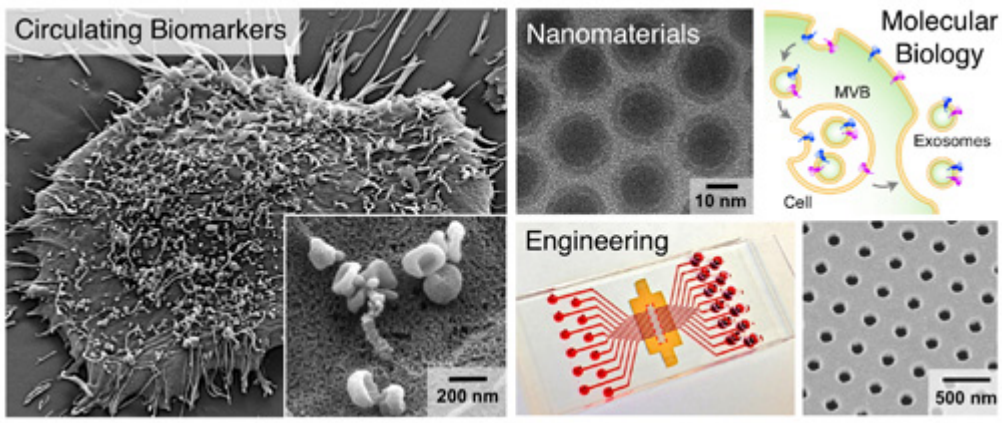
Multiscale Molecular Diagnostics

Our research goal is to create innovative technologies to empower molecular diagnostics and patient care. We aim to advance personalized medicine by taking a two-pronged approach: 1) discover novel **circulating biomarkers** for noninvasive monitoring and 2) develop transformative **biosensing technologies** to enable and translate these discoveries. Our multidisciplinary expertise spans the field of molecular biology, nanomaterials science and device engineering and has pioneered multiple platform technologies. These micro- and nanotechnology systems have expanded the clinical reach of previously under-appreciated biomarkers (e.g., exosomes) in human trials, in informing therapy selection, rationally directing trials, and improving sequential monitoring to achieve better clinical outcomes.

Our current research interests include:

1. Circulating biomarkers (e.g., exosomes, extracellular vesicles) for noninvasive diagnostics and therapeutics
2. Novel assay development for diverse molecular analyses
3. Organic and inorganic nanomaterial synthesis and applications
4. Microfluidics for point-of-care medical applications
5. Development of highly sensitive miniaturized magnetic, optical and electrical sensors

We are seeking highly motivated and talented postdoctoral fellows, students and research officers. Please contact Dr. Shao if you are interested in joining our team.



Circulating Biomarkers

Circulating biomarkers, such as circulating tumor cells, extracellular vesicles (exosomes), and soluble factors, represent a rich repertoire of molecular information. In comparison to tissue biopsies, these circulating biomarkers (“liquid biopsies”) can be repeatedly and conveniently obtained with minimal complications, thereby providing a robust and noninvasive avenue for longitudinal molecular characterization. In particular, exosomes have recently emerged as a new class of biomarker for clinical diagnostics. Exosomes are membrane-bound phospholipid

vesicles (50 – 200 nm) actively shed off by cells. These nanometer-sized vesicles possess unique advantages: they exist in large abundance in biofluids, exhibit exceptional stability, and harbor diverse molecular contents. We are investigating the potential of these circulating vesicles as novel surrogate markers in achieving clinical benefits.

Biosensor Platforms

A critical unmet need in personalized medicine is to establish reliable technologies to assess efficacy and guide treatment decisions. Despite the clinical potential of many novel circulating biomarkers, their clinical translation remains challenging, primarily because of the extensive purification and labeling processes involved in their detection and quantification. We are addressing these issues by developing new generations of nanotechnology-based platforms for molecular analyses. Our miniaturized magnetic and optical biosensors have expanded the clinical reach of previously under-appreciated biomarkers in clinical trials, by identifying novel molecular signatures for early diagnostics and progression monitoring. Drawing on the diversity and depth of multiple disciplines, our research not only engineers cutting-edge technologies, but also brings new opportunities in disease diagnostics and management, including better powered trials, improved disease monitoring, and rational selection of therapies.