Chemistry Departmental Colloquium

Leveraging Constraints to Enhance Spatial Resolution, Sensitivity, and Applications in Bioelectrical Interfaces

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Abstract: By reframing constraints as opportunities, we can strategically design experimental conditions that unlock new avenues for scientific discovery. This paradigm not only accelerates breakthroughs in fundamental research but also drives innovation in practical applications. In this talk, I will highlight our recent advancements in bioelectrical interfaces at the intersection of materials and biological systems. I will explore how we have enhanced spatial resolution to achieve precise photostimulation in cells and tissues, increased microbial sensitivity to electrical stimulation to suppress virulence, and advanced gas-phase detection of biological markers critical for addressing challenges in neonatal care. Additionally, I will present emerging bioelectronic applications, including minimally invasive optical pacing for translational medicine and cell-laden bioelectronics for inflammation treatment. These examples demonstrate how we identify pivotal questions, resolve conflicts, and harness constraints to guide transformative solutions, turning challenges into engines of discovery. I will conclude by sharing my vision for the future of bioelectrical interfaces, emphasizing how this constraints-driven approach can continue to push the boundaries of the field.

Bio: Dr. Bozhi Tian earned his Ph.D. in Physical Chemistry from Harvard University and completed postdoctoral research in regenerative medicine at the Massachusetts Institute of Technology. At the University of Chicago, his research focuses on developing new materials for bioelectronics, employing semiconductor- and electronics-based tools to investigate (sub-)cellular dynamics and soft-hard interface interactions, and the translational applications of diverse bioelectrical systems. Dr. Tian's work has been recognized with several honors, including the Raymond and Beverly Sackler International Prize in the Physical Sciences, the Presidential Early Career Award for Scientists and Engineers (PECASE), recognition as an MIT Technology Review Innovator Under 35 (TR35) in 2012, and the 2023 Faculty Award for Excellence in Graduate Teaching and Mentoring from the University of Chicago.

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