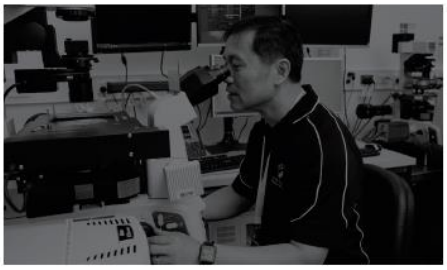

Nanopores: From Biosensors to Cell-Instructive Interfaces

Prof Morteza Aramesh
Institute for Biomedical Engineering, ETH Zürich.

01:00pm, 04/12/2024
At the Boardroom, Melbourne Centre for Nanofabrication
151 Wellington Road, Clayton, 3168
Zoom link: click here
Meeting ID: 856 9549 7894 and passcode: 574455

Nanopores: From Biosensors to Cell-Instructive Interfaces

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Abstract: Our research bridges physics, materials science, and biology to explore living organisms down to the molecular level. Nanomaterials are central to our work. We have developed methods to fabricate and functionalize nanomaterials, tailoring them for biomedical applications. This includes designing sensors for localized detection of ions and biomolecules, and creating cell-instructive materials that can alter cellular functions for immunotherapy applications.

In this seminar, I will present our latest research on tailoring nanomaterials for biosensing and cellular engineering applications. We will explore the creation of nanopore sensors that operate near or even inside single cells, offering real-time insights into cellular functions and processes.

Next, we will discuss how cells interact with nanomaterials and how nanotopographical constraints can alter immune cell functions and gene expression patterns. By using nanoporous surfaces, we have shown that these constraints induce biomechanical signals, leading to potent activation of T and B cells. The induced formation of cellular protrusions (microvilli) inside the nanopores significantly enhances cellular uptake through macropinocytosis. This provides a novel platform for gene or drug delivery to the cells, enabling manufacturing of genetically engineered cells (CAR-T cells) for potential applications in immunotherapy.

Relevant publications:

1. "Superplastic nanoscale pore shaping by ion irradiation" *Nature Communications*, 2018
2. "Localized detection of ions and biomolecules with a force-controlled scanning nanopore microscope" *Nature Nanotechnology*, 2019
3. "Enhanced Cellular Uptake through Nanotopography-Induced Macropinocytosis" *Advanced Functional Materials*, 2024
4. "Nanoconfinement of microvilli alters gene expression and boosts T cell activation" *PNAS*, 2021

About the speaker:

Prof. Morteza Aramesh is an Assistant Professor at ETH Zürich's Institute for Biomedical Engineering. He received his PhD in Physics from the University of Melbourne in 2016. In 2024 he secured an ERC starting grant and is now leading the Laboratory for Single-Molecule and Single-Cell Biophysics at ETH Zurich. His research focuses on developing nanopore-based tools to monitor protein production and secretion at the single cell level.