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MOLECULAR, VESICULAR, AND CELLULAR PROFILING USING A SINGULAR NANOPORE: WHAT INFORMATION IS OBTAINABLE?

Kevin J Freedman

University of California Riverside, U.S.A.

Abstract

The molecular machinery that permits the existence of cellular life is immensely more complex than originally thought by the early scientists who discovered them. Macromolecules can deform and change shape, not only as a function of time, but also as they migrate within chemical gradients such as the intracellular environment. Even clonal copies of cells and vesicles are diverse and unique; characterized not by a single prototype but made up of sub-populations. It seems as though engineering diversity is one way that life encodes functionality. With the goal of studying sub-populations and the properties of those cellular entities and sub-structures, we use a class of nanoscale devices called nanopores. Molecules, vesicles, and cells are driven through singular pores (or apertures) while recording the flow of background (electrolyte) ions. Based on this rather simple process, physiochemical properties of the molecule can not only be sensed (e.g. intramolecular information like DNA sequence) but also manipulated. Protein, DNA, and lipid-membranes can be deformed in the moments (i.e. microseconds) leading up

to entering the pore and can elucidate medically-relevant properties of these essential building blocks of the cell, or characterize the biosynthetic constructs that scientist build in the lab. The biophysics of molecular transport and the technological advances that make these recordings possible will be highlighted.

Speaker's Bio

Dr Kevin Freedman's group at the University of California Riverside is focused on fabricating nanoscale devices and studying transport phenomenon and biophysics. As a Whitaker Fellow, he was a post-doc at Imperial College London (UK) in the laboratory of Prof. Joshua Edel. At this position, he worked on single-molecule trapping technology using dielectrophoresis (DEP) and nanopore technology. Other projects included the engineering of DEP-enhanced Raman spectroscopy, among others. After leaving Imperial College London, Dr Freedman was a senior fellow at Global Viral and LBNL's Joint Genome Institute working on single-cell genomics, metagenomics, and bias-free 16S sequencing. His PhD, in Chemical and Biological Engineering, was obtained at Drexel University while in the laboratory of Prof. MinJun Kim. During his doctoral work, Dr Freedman demonstrated that single proteins unfold one at a time as they pass through a nanopore via electric field denaturing forces and verified using single point mutants. Dr Freedman has also held visiting scientist positions at KAIST (South Korea), University of Pennsylvania (USA), and Uppsala University (Sweden).