School of Molecular Sciences
Arizona State University

SMS Spring 2023 Seminar Series

Friday Jan 27 | 3pm | Biodesign Auditorium

Proteins as the New Silicon? How Protein Electronics might Work:

Browning We think of proteins as molecular solids in which charge is entirely localized. But it is difficult to reconcile this picture with a mounting body of evidence that shows that most proteins are conductors (on the scale of intrinsic semiconductors) while some (the oligocytochrome filaments of geobacter) appear to be metallic. We have explored this conductivity experimentally, using the scanning tunneling microscope to make electrical contacts to single protein molecules. The decay of conductance with distance is remarkably slow, with nanoSeimen conductance at distances in excess of 10 nm, making ordinary proteins better molecular wires than the purpose-built molecular wires that have been synthesized by organic chemists.
In a recent collaboration, we have simulated the dynamics of a series of proteins whose characteristics have been measured experimentally. We find that incoherent vibronic hopping can account for the long range conductivity. This is because the electron transfer rate between aromatic residues is much faster than the environmental relaxation that would trap a radical cation state, leading to a much reduced reorganization energy and thus a barrier to hopping that is not much larger than thermal energy. This reduced reorganization energy also accounts for the fact that these non-equilibrium oxidation states are quite well aligned with the Fermi energy of gold electrodes. The most obvious technological application of these phenomena is to interface silicon directly with enzymes, a project we are pursuing by embedding polymerase molecules in solid state chips.
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Stuart Lindsay, PhD

Regents Professor, Arizona State University

Center Director & Professor, Biodesign Center for Single Molecule Biophysics

Stuart Lindsay director of the Center for Single Molecule Biophysics in the Biodesign Institute at Arizona State University, a University Professor, a Regents Professor, and Nadine and Edward Carson Presidential Chair of Physics and Chemistry. He holds 55 U.S. patents and is co-founder of Molecular Imaging (now part of Agilent Technologies) and more recently, Recognition AnalytiX. He is the author of Introduction to Nanoscience (Oxford University Press), and is a fellow of the National Academy of Inventors, the American Physical Society, the American Association for the Advancement of Science and the Institute of Physics.

Professor Lindsay's research focuses on nano-scale biophysics. He has pioneered aspects of atomic force microscopy, particularly those related to imaging and chemical analysis in water. Current research interests include nanoscale chemical mapping, applications of nanoscience for sustainable energy, new techniques for DNA and protein sequencing based on electron tunneling, and nanoscale probes of epigenetic markings and cell biochemistry.

**ZOOM option available: https://asu.zoom.us/j/87081218152*