UNIVERSITY OF CALIFORNIA, IRVINE

THE DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

Is Proud to Host a Seminar by:

PROFESSOR NATHAN GIANNESCHI

Dept. of Chemistry, Materials Science and Engineering, Biomedical Eng. & Pharmacology
Northwestern University

Thursday, April 13, 2023
2:00-3:20 PM
Location:
McDonnell Douglas Engineering Auditorium

Proteomimetic Polymers as Therapeutics: A Materials Science Approach to Drugging the Undruggable

Abstract: In this presentation, we will describe the organization of functional peptides as densely arrayed sidechains on polymer scaffolds as leading to a new class of proteomimetic material. We call these materials, Protein-Like Polymers (PLPs), wherein peptide-brush polymers are composed from monomers, each containing a peptide side-chain. Peptides organized in this manner imbue polymers with a range of functional qualities inherent to their specific sequence. Therefore, polymers otherwise lacking bioactivity, or responsiveness to stimuli, once linked to a peptide of choice, can now bind proteins, enter cells and tissues, have controlled and switchable biodistribution patterns, and exhibit exceptionally long half lives in circulation (days to weeks). Synergistically with the peptide influencing the polymer, the polymer enforces changes in peptide activity and function by virtue of packing and constraining the peptide. For example, the scaffold can protect the peptide from proteolysis, change the pharmacokinetic profile of an intravenously injected peptide, increase the cellular uptake of an otherwise cell impermeable therapeutic peptide, or change peptide biological activity. Moreover, in addition to the sequence-controlled peptides (generated by solid phase synthesis) the polymer can carry its own sequence-dependent information, especially through living polymerization strategies allowing well-defined blocks and terminal labels (dyes, contrast agents, charged moieties). Hence, the two elements, peptide and polymer, cooperate to yield materials with unique function and properties quite apart from each alone. We will describe the development of synthetic strategies for accessing this class of biomolecule polymer conjugate, discuss their physicochemical and structural properties and will describe their utility in a range of settings, including as a new type of therapeutic modality. We will highlight some examples of biomedical applications including their ability to engage critical intracellular protein-protein interactions driving neurodegenerative disease and cancer.

Bio: Nathan C. Gianneschi received his B.Sc(Hons) at the University of Adelaide, Australia in 1999. In 2005 he completed his Ph.D at Northwestern University. Following a Dow Chemical postdoctoral fellowship at The Scripps Research Institute, in 2008 he began his independent career at the University of California, San Diego where, until June 2017, he was Teddy Traylor Scholar and Professor of Chemistry & Biochemistry, NanoEngineering and Materials Science & Engineering. In July of 2017, Gianneschi moved his research group to Northwestern University where he is currently Jacob & Rosaline Cohn Professor of Chemistry, Materials Science & Engineering, and Biomedical Engineering. The Gianneschi group takes an interdisciplinary approach to nanomaterials research with a focus on multifunctional materials with interests that include biomedical applications, programmed interactions with biomolecules and cells, and basic research into nanoscale materials design, synthesis and characterization. For this work he has been awarded the NIH Director's New Innovator Award, the NIH Director's Transformative Research Award and the White House's highest honor for young scientists and engineers with a Presidential Early Career Award for Scientists and Engineers. Prof. Gianneschi was awarded a Dreyfus Foundation Fellowship, is a Kavli Fellow of the National Academy of Sciences, a Fellow of the Royal Society of Chemistry, and is an Alfred P. Sloan Foundation Fellow.