Yale Institute for Nanoscience and Quantum Engineering

Friday- November 13, 2015

12:00 to 1:00 p.m.

BECTON SEMINAR ROOM

Light lunch will be served at 11:45 a.m.

Nikhil Malvankar

Department of Molecular Biophysics and Biochemistry, Yale University

“Metal-like transport in proteins: A paradigm shift for biomaterials”

Electronic nanostructures made from natural amino acids are attractive due to their low cost, facile synthesis and absence of toxicity. However, most biomaterials are electronically insulating. Electron transport in proteins generally occurs through inorganic co-factors via tunneling or hopping mechanism and the possibility of electron delocalization or metal-like conductivity has been considered previously impossible. In this talk, I will present our recent work on protein nanofilaments, pili, of electricity-producing Geobacter sulfurreducens that challenges this long-standing belief. Using nanoelectrodes and scanning probe microscopy-based imaging approach to quantify electron transport in native proteins, we have found out that pili propagate charges in a delocalized manner similar to carbon nanotubes, enabling cells to generate electricity and produce methane via cell-to-cell electrical connections. Structural and molecular studies revealed that conductive pili possess unique arrangement of aromatic amino acids that facilitate intermolecular electron delocalization. I will present strategies to genetically engineer electronic properties of these protein-based nanomaterials for energy, environmental and bioelectronics device applications such as fuel cells, transistors and supercapacitors.

Tarek Fahmy

Department of Biomedical Engineering, Yale University

"The Adaptive Immune System as a highly Advanced Controller: Inputs, Outputs, control and Intervention"

The immune system is a complex network of molecules, cells, and tissue that screen its own components, protect the body, and attack invaders such as bacteria or viruses. As such, the Immune system is a Distributed Control System (DCS) defined as multiple elements, not centralized,that control a process output based on input parameters and internal setpoints. Understanding how the immune system works has been the focus of decades of hard work and multiple nobel prizes in medicine and biology. Only recently, however, did Engineers become interested and with this interest the beginnings of a paradigm shift in how we perform immunotherapy and use diagnostics for surveying immunity is taking place. While, the immune process inputs, outputs, set points and output are well-established, how the controller functions to yield specific outputs remains enigmatic. Here I will compare and contrast what we know about DCS and Immune system architecture and function. Then, I will discuss how immune modulation is currently performed in clinical settings. Finally, I will end with a series of questions that outline how unrelated challenges and their solutions in DCS controlled processes such as the chemical process industry may serve to address and/or assist some of the most challenging health problems of today. Involving restoration of immune competence, vaccine development, and cancer immunotherapy.

Host: Professor Eric Altman