Room 404AB: Sunday, February 16

3:30 PM – 5:00 PM
Mad City Labs Inc

Applications of Single Molecule Microscopy: Development Signaling to Sustainability Efforts
This session will feature research performed using single molecule microscopy techniques. Penn State researchers will describe employing single molecule microscopy techniques to solve problems related to biofuels and microplastics, while research from UT-Austin will demonstrate the potential of single-cell, single-molecule biochemistry for understanding developmental signaling.

Applying Single-Molecule Microscopy Techniques to Sustainability Research
Speakers: William Hancock, Professor of Biomedical Engineering and Daguan Nong, Assistant Research Professor of Biomedical Engineering, Pennsylvania State University
Two pillars in sustainability research are using cellulase enzyme to generate biofuels from lignocellulose feedstocks, and developing enzymes that can degrade plastic waste. In this talk, we will describe biophysics research toward these goals that uses a custom-built Total Internal Reflection Flurorescence (TIRF) and Interferometric Scattering (IRM) microscope. Cellulases extract a strand from crystalline cellulose and processively degrade it. By imaging quantum-dot labeled Cel7 cellulase enzymes, we are able to observe enzymes landing on immobilized cellulose, moving at ~3 s^{-1} for tens of nm. PETases, discovered in 2016, degrade polyethylene terephthalate. We are investigating the reversible binding kinetics of Qdot-labeld PETase enzymes to infer their catalytic mechanism. These projects demonstrate how single-molecule microscopy can be applied to sustainability research.

Multivalent Assembly of PAR-3/aPKC Complexes Establishes Cell Polarity in *C. elegans* zygotes
Speaker: Sheng-Ping Hsu, Graduate Student (Dickinson Lab), University of Texas - Austin
Protein-protein interactions drive cell signaling and behavior. Studying these interactions *in vitro* is laborious and does not capture the cellular context where interactions occur. We utilize single-cell, single-molecule techniques to examine protein interactions *in vivo*. Here we present our unpublished work on cell polarity proteins in *C. elegans*. Using rapid single-cell lysis and single-molecule pull-down, we discovered cooperative assembly and oligomerization of a key polarity complex. We used near-TIRF imaging with chimeric labeling in living embryos to verify that the cooperativity occurs *in vivo*. Moreover, we integrate mutants, knockdowns, and drug treatments to determine that cooperativity results from multivalency and is essential for normal development. Overall, this study demonstrates the potential of single-cell, single-molecule biochemistry for understanding developmental signaling.