Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

BME Seminar Series Presents

"Nanomaterials Engineering to Probe and Control Living Systems"

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Chan-Zuckerberg Biohub Investigator

Markita Landry is an assistant professor in the department of Chemical and Biomolecular Engineering at the University of California, Berkeley. She received a B.S. in Chemistry, and a B.A. in Physics from the University of North Carolina at Chapel Hill, a Ph.D. in Chemical Physics from the University of Illinois at Urbana-Champaign, and completed a postdoctoral fellowship in Chemical Engineering at the Massachusetts Institute of Technology. She is a recent recipient of early career awards from the Brain and Behavior Research Foundation, the Burroughs Wellcome Fund, The Parkinson's Disease Foundation, the Beckman Young Investigator program, is a Sloan Research Fellow, an FFAR New Innovator, a DARPA Young Investigator, and is a Chan-Zuckerberg Biohub Investigator. The Landry lab exploits the highly tunable chemical and physical properties of nanomaterials for the creation of bio-mimetic structures, molecular imaging, and gene editing.

ABSTRACT

Unique physical, chemical, and optical phenomena arise when materials are confined to the nano-scale. Our lab focuses on understanding and exploiting tunable optical and chemical properties of nanomaterials to probe and control biological systems. We present recent work on nanosensor-based imaging of brain neurochemistry, in efforts to better understand how antidepressants and antipsychotics affect the kinetics of neuromodulation. We characterize our findings in the context of their utility for high spatial and temporal neuromodulator imaging in the brain with 2-photon microscopy (O'Donnel et al. 2017), describe nanosensor exciton behavior from a molecular dynamics and quantum mechanics perspective, and validate nanosensors for use in vivo to correlate external stimuli (experiences, behavior) to chemical output (neurotransmission) (Beyene et al. 2017). We will also discuss how nanomaterials can be synthesized to carry biomolecular cargo to living systems. In particular, we implement high aspect ratio nanomaterials to enable genetic engineering of plants. In this manner, nanomaterials circumvent the physical barrier presented by the plant cell wall, which has limited the ease and throughput with which exogenous biomolecules can be delivered to plants. We will describe how nanomaterials engineering principles can be leveraged to manipulate living plants, in efforts to reconcile the benefits of crop genetic engineering with the demand for non-GMO foods (Demirer et al. 2018). Our work in the agricultural space provides a promising tool for species-independent, targeted, and passive delivery of genetic material, without transgene integration, into plant cells for rapid and parallelizable testing of plant genotype-phenotype relationships.

Del Bonis O'Donnell, J.T., Page, R.H., Beyene, A.G., Tindall, E.G., McFarlane, I.R., Landry, M.P.‡ Molecular Recognition of Dopamine with Dual Near Infrared Excitation-Emission Two-Photon Microscopy. Advanced Functional Materials (2017). DOI: 10.1002/adfm.201702112

Beyene, A.B., McFarlane, I.R., Pinals, R.L, Landry, M.P.‡ Stochastic Simulation of Dopamine Neuromodulation for Implementation of Fluorescent Neurochemical Probes in the Striatal Extracellular Space. ACS Chemical Neuroscience (2017). DOI: 10.1021/acschemneuro.7b00193

Demirer, G.S., Chang, R., Zhang, H., Chio, L., Landry, M.P.‡ Nanoparticle-Guided Biomolecule Delivery for Transgene Expression and Gene Silencing in Mature Plants. bioRxiv (2018). DOI: 10.1101/179549

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