CHEMICAL ENGINEERING

SEMINAR SERIES

MARKITA LANDRY

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Imaging Striatal Dopamine Release With a Non-Genetically Encoded Near-Infrared Fluorescent Nanosensor

ABSTRACT: Neurons communicate through chemical neurotransmitter signals that either terminate at the postsynaptic process ("wired transmission") or diffuse beyond the synaptic cleft to modulate the activity of larger neuronal networks ("volume transmission"). Molecules such as dopamine belong to the latter class of neurotransmitters, and have been the pharmacological targets of antidepressants and antipsychotics for decades. Owing to the central role of dopamine over a range of behaviors and psychiatric disorders, real-time imaging of the signal's spatial propagation would constitute a valuable advance in neurochemical imaging. To this end, we present a nanoscale near-infrared fluorescent nanosensor for dopamine and demonstrate its efficacy for imaging dopamine volume transmission in the extracellular space of the brain striatum and prefrontal cortex (Beyene et al. ACS Chem. Neuro. 2017). The sensor is developed from polymers pinned to the surface of single wall carbon nanotubes (SWNT) in which the surface-adsorbed polymer is the recognition moiety and the carbon nanotube the fluorescence transduction element. Excitonic transitions in functionalized SWNT yield up to $\Delta F/F$ = 4500% near-infrared fluorescence emission in the presence of dopamine (Beyene et al. Nano Letters 2018). We next demonstrate imaging of evoked dopamine release in acute striatal slices, and show disrupted dopamine reuptake kinetics when brain tissue is exposed to dopamine agonist and antagonist drugs (Beyene et al. bioRxiv 2018). Lastly, we discuss a new form of imaging for deep-brain neuromodulator detection: double infrared excitation-emission fluorescence microscopy (O'Donnell et al. Adv. Funct. Mater. 2017). We characterize our findings in the context of their utility for high spatial and temporal neuromodulator imaging in the brain, describe nanosensor exciton behavior from a molecular dynamics (MD) perspective, and validate nanosensor for use in vivo to correlate external stimuli (experiences, behavior) to chemical output (neurotransmission).

BIOGRAPHY: 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. Her current research centers on the development ofsynthetic nanoparticle-polymer conjugates for imaging neuromodulation in the brain, and for the delivery of functional biomolecules and nutrients into living systems. 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. 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 DARPA Young Investigator program, the Beckman Young Investigator program, the Howard Hughes Medical Institute, is a Sloan Research Fellow, an FFAR New Innovator, and is a Chan-Zuckerberg Biohub Investigator

RECEPTION 3:30 • LECTURE 4:00 – 5:00
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