PennState College of Engineering | BIOMEDICAL ENGINEERING

Seminar Series

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Supramolecular Biomaterials with Bio-Inspiration

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ABSTRACT

Nature abounds with elegant structures and functions which inspire the preparation of synthetic biomaterials and drug delivery devices. Nanoarchitectures present in biological systems arise from precisely engineered molecular-scale interactions, with active perturbation of environmental conditions modulating the free energy landscape governing material formation. Such phenomena inspire the design of biomaterials with precise nanoscale organization, combining stabilizing or destabilizing stimuli to realize responsive therapeutic functionality on demand. Dr. Matthew Webber's lab is engineering systems that adjust aggregation state in response to biological triggers, such as glucose, to deliver therapeutics and treat disease in real time with actively sensing material platforms. Nature similarly achieves function through non-covalent recognition, with interactions such as biotin-avidin and antibody-antigen proving especially useful in facilitating recognition in a complex biological milieu. Host–guest supramolecular recognition offers a synthetic mimic of these affinity motifs. Tuning molecular-scale affinity enables control over the bulk dynamics of a biomaterial, translating to tunable release of encapsulated payloads, dictating the rate of cell infiltration, and controlling the timescale of material clearance *in vivo*. Certain host–guest interactions have affinities sufficient for recognition in complex or contaminated environments and offer a new non-biological axis for drug homing and retention at desired sites in the body. As such, the ability to leverage non-covalent interactions from a variety of synthetic motifs enables aspects of natural biological materials and systems to be replicated, with specific functional utility in the delivery of therapeutics and creation of new biomaterials.

BIO

Dr. Matthew Webber is an associate professor in the Department of Chemical and Biomolecular Engineering at the University of Notre Dame, with a concurrent appointment in the Department of Chemistry & Biochemistry. His research group is interested in applying supramolecular principles, leveraging defined and rationally designed non-covalent interactions, to improve biomaterial practice. He is specifically curious about the possibilities for high-affinity interactions to overcome barriers in drug delivery. Dr. Webber received a bachelor of science in chemical engineering from the University of Notre Dame and a doctorate in biomedical engineering from Northwestern University. Subsequently, he was a National Institutes of Health National Research Service Award (NIH NRSA) postdoctoral fellow at the Massachusetts Institute of Technology. His research passion is to contribute to bringing the field of supramolecular biomaterials to prominence. He was named by the American Institute of Chemical Engineers as one of the "35 under 35" young leaders shaping the field in 2017 and is a recipient of a National Science Foundation CAREER award in 2020.

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