LSU College of Engineering

Chemical Engineering

LECTURE SERIES

Dr. Nicholas Sandoval

Associate Professor
Tulane University
Tuesday, November 12
10:30-11:30 pm
1124 Patrick Taylor Hall

Bacteriophage & Biosensors: Repurposing Nature for Biotechnology

Biotechnology repurposes natural biological phenomena for humanity's use. Natural biological systems, however, require engineering to optimize for desired characteristics. This has historically been an incremental process where the underlying genetic material is allowed or forced to mutate, and improved characteristics are selected for. A step change in the ability to engineer biological systems has been enabled recently by advances in DNA sequencing and synthesis technologies as well as a multitude of new genetic editing tools. In this talk, I will discuss two projects where we use these tools to engineer native genetic material for biotechnological purposes.

First, I will discuss engineering allosteric transcription factor (aTF)-promoter pairs using a massively parallel reporter assay for improved biosensing and regulation capabilities. These aTF-promoter pairs can enable user-defined gene expression both as sensing elements, where environmental inputs result in 'readable' outputs, and as DNA-based 'knobs', where user-defined inputs result in precise levels of expression. To make these parts, we elucidate the sequence–function relationship using a 'sort-seq' method to assay the interaction between the aTF and DNA at the nucleotide level with applications in both E. coli and Clostridium.

Next, I will discuss engineering bacteriophage using Cell-Free Bacteriophage Synthesis (CFBS). Bacteriophage have the potential to be powerful antimicrobial agents, but limitations in sourcing, engineering, and production inhibit broad use and commercialization. CFBS is an approach to overcome the limitations of standard phage production methods by manufacturing phage virions in vitro. CFBS mimics intracellular phage assembly using transcription/translation machinery (TXTL) harvested from bacterial lysates and combined with reagents to synthesize proteins encoded by a phage genomic DNA template. TXTL harvested from wild type or commonly used strains are not optimized for bacteriophage production, however. In this work, we demonstrate that TXTL from genetically modified E. coli BL21 can be used to enhance phage T7 yields in vitro by CFBS. We also discuss using this platform for rapid bacteriophage genome engineering with implications for improved phage therapy.

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Bio:

Nicholas Sandoval is an Associate Professor in the Department of Chemical and Biomolecular Engineering at Tulane University. Prior to joining the faculty, Dr. Sandoval was a postdoctoral researcher in the Department of Chemical and Biomolecular Engineering at the University of Delaware in the Papoutsakis research group with support from an NIH National Research Service Award. He earned his Ph.D. in 2011 at the University of Colorado Boulder in Ryan Gill's research group with support from an NSF Graduate Research Fellowship. Additionally, Dr. Sandoval was a lecturer in the Colorado Mesa University/University of Colorado Mechanical Engineering Partnership Program in Grand Junction, Colorado. Dr. Sandoval has been awarded the Tulane Rising Star Award (2022), the NSF CAREER Award (2019), and ORAU's Ralph E. Powe Junior Faculty Award (2018).