CBST Seminar

Center for Biomanufacturing Science & Technology

UNIVERSITY OF DELAWARE

DATE:

May 2, 2017

TIME:

1:00 p.m.

LOCATION:

366 Colburn Lab

Dr. Bryan Berger

Department of Chemical & Biomolecular Engineering

Lehigh University

Bryan Berger is the Class of 1961 Associate Professor of Chemical and Biomolecular Engineering at Lehigh University. His research is focused on problems at the interface of biology and engineering, with applications in diverse areas such as mechanisms of transmembrane signal transduction, scalable biosynthesis of advanced functional nanomaterials, biosurfactant design to improve drug bioavailability and biofilm structure in multi-drug resistant pathogens. Research in the Berger group is support by grants from the NSF, NIH and industrial research groups, and has been recognized with a 2015 NSF CAREER award.

"Biomanufacturing of Advanced Functional Materials for Energy & Pharmaceutical Applications"

Biomanufacturing is an enabling route to high-yield, sustainable and green production of advanced materials. In contrast to chemical synthesis, in which toxic solvents, high temperatures and pressures are typically required, biological systems can control material synthesis and properties under ambient conditions. In this talk, I will share approaches from our lab that demonstrate the ability of biological systems to biomanufacture high-value materials.

First, I will discuss our work re-engineering the intrinsic heavy-metal resistance of Stenotrophomonas maltophilia to develop a biomanufacturing method for inorganic nanocrystal biosynthesis that is inherently green, enabling low-cost, scalable production of size-controlled crystalline nanoparticles such as quantum dots (QDs) under benign conditions directly from aqueous solutions. We estimate yields on the order of grams per liter from batch cultures under optimized conditions, and are able to reproducibly control nanocrystal size and optical/catalytic properties. We are able to generalize this approach to include metals such as cadmium, lead, copper, indium and zinc, metal sulfides and selenides as well as core-shell nanocrystals, and demonstrate function in key applications such as solar cells and biomedical imaging. The results of this work also illustrate unique mechanism bacteria such as S. maltophilia have evolved to detoxify metal-containing solutions, which can be used for materials design.

Second, I will discuss our work designing a scalable, recombinant system for high-yield biosurfactant design and synthesis. Poor drug solubility is a major limitation to developing effective, commercial-scale drug delivery systems; it is estimated that more than 40% of all current drugs in preclinical development fail due to low solubility, at an estimated cost of more than $100 million per drug. Additionally, there are increasing concerns regarding the biocompatibility of synthetic surfactants such as Tween 80, which can cause severe side effects such as anaphylaxis in IV chemotherapeutic formulations. I will describe our approach to engineering a protein-based biosurfactant (HYD) to improve drug solubility, biocompatibility and targeted delivery. In particular, I will highlight our approach to achieving scalable synthesis of designed biosurfactants, and methods to engineer specific, "switchable" functionalities such as pH-dependent surface activity into the designed biosurfactants for drug formulation and other bioprocess applications.