

UCSD NANOENGINEERING/CHEMICAL ENGINEERING  
**SEMINAR SERIES**

Wednesday, May 31st, 2023

Seminar Presentation: 11:00am - 12:00pm

**SME room 248*****“Guns, Germs, and MOFs”*****Dr. Jeremiah Gassensmith, PhD***Associate Professor  
University of Texas at Dallas*

**Abstract:** We have shown that zeolitic imidazolate frameworks (ZIFs), a subclass of a much broader family of materials called Metal-Organic Frameworks (MOFs), can enhance the stability and adjuvanticity of vaccine formulations. ZIFs are crystalline porous metal-coordination polymers with outstanding thermodynamic stability. Their structural rigidity is attributed to the interconnection of organic ligands and metal nodes that extend infinitely in all directions. ZIF-8 comprises zinc ions coordinated to 2-methylimidazole (HMIM) in the repeating framework. ZIF-8 spontaneously grows on biomacromolecules, immobilizing them inside a crystalline matrix. Simply mixing biomolecules, ligand, and zinc salts produce fully encapsulated material in only a few seconds. With bacteria, the surface becomes heavily armored in many individual crystals, whereas smaller macromolecules, such as proteoliposomes, can be entrapped in a single crystal. The resulting ZIF-8 shell has exceptional stability against temperature variation, enzymatic degradation, and moisture but is kinetically labile in the presence of metal chelators like EDTA and inorganic phosphates, making ZIF-8 an ideal material for reversible immobilization.

In this talk, I will discuss how the thermodynamic stability of MOFs help protect delicate protein antigens from denaturation, potentially allowing the refrigeration-free storage of vaccines and biological drugs. I will further show how the kinetic lability in the presence of biological media help promotes a slow release of antigens that facilitates improved antibody production by promoting germinal center formation. In particular, I will focus on a project to create a vaccine against UTI-causing bacteria using a whole-cell approach. Finally, I will discuss a new method to control the delivery of biological therapeutics into the skin using compressed gas fired from a homemade gun.

**Biosketch:** I am a native of Oaklandon, Indiana. I earned my B.Sc. degree (with honors) under the tutelage of Professor Joseph Gajewski at Indiana University in Bloomington and my Ph.D. from Professor Bradley D Smith at the University of Notre Dame. After my PhD, I traveled to Northwestern University and studied under Professor Sir J. Fraser Stoddart (Nobel Laureate 2016). I joined the faculty at the University of Texas at Dallas in August 2013. I have two boys, write grants, golf poorly, and cook food. Select accolades: NSF CAREER (2017) ACS PRF New Investigator (2016), Various teaching awards (2015, 2021), Elected Fellow of the Royal Society of Chemistry (2022).