

Department of Chemistry and Biochemistry

School of Integrated Science and Humanity

Seminar Announcement

Design of Multifunctional Nanomaterials Based on Artificial and Natural Supramolecular Structures

DATE

FRIDAY, OCTOBER 4TH OF 2019

TIME

11:00 AM to 12:00 PM

LOCATION

AHC3-205 MMC (LIVE) & AC2-210

The event is free and open to the public.

Dr. Cheng-Yu Lai
Visiting Associate Professor

Department of Mechanical and
Materials Engineering

Florida International University



Abstract

Porous nanomaterials offer superb platforms to accomplish chemistry at the nanoscale, especially in interaction with biological systems and the environment. The presentation will focus on two systems, a synthetic porous nanomaterial, Mesoporous Silica Nanosphere (MSN) and a naturally occurring hollow nanostructure, the vault, ubiquitous in all eukaryotic cells. MSNs feature well-defined architectures, resulted from the synthetic conditions, and are amenable to accommodate functionality on the pores' internal surface, creating cavities reminiscent of enzyme scaffolds, where chemistry is accomplished through cooperative participation of various functional groups. In addition, the scope of the application could be expanded by selectively adding functionality to the exterior surface of the nanospheres. A few applications will be discussed, including a universal transmembrane carrier for intracellular drug/gene delivery and a simple carbon dioxide capture nanomaterial. The presentation will further introduce a naturally-occurring nanoparticle and discuss the biological synthesis of the vaults and offer a general perspective for their present and potential future applications. In a quest for developing a flexible, targetable, non-immunogenic nanocapsule with potential in intracellular delivery of large molecules such as genes or oligopeptides/proteins, the vault seems to be an excellent candidate. Several studies revealed that the major vault protein (MVP), one of the major protein components of the nanocapsule, is responsible for the highly organized architecture of the vaults. Thus, MVP formed vault became a workhorse for nanotechnology. The proof-of-concept for protein encapsulation and delivery was demonstrated using the Green Fluorescent Protein (GFP) as "cargo" protein.

Biography

Dr. Cheng-Yu Lai obtained his Ph.D. from Iowa State University (Ames, IA) in Inorganic Chemistry in 2004 working under the supervision of late Prof. Victor Lin in the field of nanomaterials with biomedical applications. He then continued his preparation as a Postdoctoral Fellow at The Scripps Research Institute from 2005 to 2007, in the group of Prof. Glen Nemerow. Working in the Department of Immunology at Scripps, he acquired a completely new set of skills, involving molecular biology and cell biology techniques, toward understanding the fundamental mechanisms that underlie the interaction of nanomaterials with living cells. Dr. Lai further joined DuPont Central Research and Development at the Experimental Station in Wilmington, DE, as a research scientist in the Biomaterials Group. Here he developed stimuli-responsive polymeric vesicles for delivery of adhesion prevention molecules in wound healing. He then moved to academia in August 2012 at Delaware State University, in Dover, DE as an associate professor of chemistry on tenure-track. Dr. Lai, started a research program with the central theme on Sustainable chemistry and utilized mesoporous silica nanospheres as a vehicle in many applications, including mitigation of carbon dioxide emissions, cascade enzymatic catalysis for conversion of non-food waste feedstocks into food, and catalysts for renewable energy. In addition to research, he dedicated a significant effort in developing undergraduate research programs and curricular enhancements. In 2016, Dr. Lai was promoted to Associate Professor with tenure. He received several grants from NSF, DOE, DOD, USDA and NIH (NIGMS IDeA Pilot). He graduated two Master's and two Ph.D students and mentored several undergraduate students; all successfully placed either in industrial or government jobs, or further matriculated into graduate programs. Dr. Lai moved to FIU in August 2018 as a Visiting Associate Professor in the Department of Mechanical and Materials Engineering, continuing his work in the porous materials and expanding into the area of nanomaterials in the 2-dimensional (2D) realm.

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