USC Viterbi
School of Engineering
Ming Hsieh Department of Electrical and Computer Engineering

Ming Hsieh Institute Seminar Series

Semiconductors and Microelectronics Technology

Towards Designing Functionality: Nano-Architected Materials for Next-Generation Sustainability and Health Monitoring

Yuanwei Li, Ph.D.

Postdoctoral Fellow, Stanford University

Date: Thursday, September 12, 2024
Time: 2:30pm – 3:30pm
In-person: EEB 132

Abstract: A central aim in materials science is the ability to dictate functionality through deliberate design rules, leading to the synthesis and characterization of targeted structures. Inspired by natural materials' assembly and optical properties, my research develops nano-architected materials from nanoscale to macroscale, each tailored with specific chemical and optical properties. This talk will delve into the intersection of chemistry, nanomaterials, and optical physics to innovate materials for enhanced sustainability and health monitoring applications.

My research focuses on designing functional colloidal crystals using principles inspired by the geometric intricacies observed in natural systems. Employing DNA-functionalized inorganic nanoparticles as the building blocks, I have developed multicomponent and porous colloidal crystals through programmable assemblies, advancing the complexity achievable in crystalline structures. These crystals are engineered to possess unique functionalities such as negative refraction, broadband absorption, and significant mechanical robustness. Moreover, I address synthetic challenges in creating porous crystals with tunable pore sizes ranging from 10 to 1000 nm, which can be employed in applications from advanced catalysis to optical devices like invisibility cloaks and miniaturized mechanical components.

I extend my expertise to designing intricate metamaterials that synergize bottom-up assemblies with top- down lithography for health monitoring by developing optical biosensors. Focusing on the continuous, multiplexed monitoring of key metabolites associated with chronic stress, my approach integrates high-quality-factor dielectric metasurfaces with plasmonic spherical nucleic acids composed of modular DNA aptamer probes. Demonstrating sub-picomolar sensitivity, this optical sensor enables real-time, multiplexed detection across dense arrays of resonators, potentially revolutionizing portable health monitoring systems.

Biography: Yuanwei Li is a postdoctoral fellow in Materials Science and Engineering at Stanford University, as a Stanford Science Fellow under the guidance of Prof. Jennifer Dionne. She focuses on developing new optical nanomaterials for biosensing and photocatalysis. She received her PhD in Chemical and Biological Engineering at Northwestern University as a Ryan Fellow, working with Prof. Chad Mirkin. Her graduate research focused on the programmable assembly of nanoparticles into colloidal crystals with tailored chemical, optical, and mechanical properties by design. Her work has been published in Nature, Science, Nature Materials, and Science Advances. She received the MRS Graduate Student Award, Outstanding Research Award by the International Institute for Nanotechnology, the SPIE Optics and Photonics Education Scholarship, and has been named a Rising Star in Chemical Engineering by MIT.

Hosted by Prof. Jayakanth Ravichandran, Prof. Jianhua (Joshua) Yang, Prof. Chongwu Zhou, Prof. Stephen Cronin, Prof. Wei Wu.
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