INFORMATION ABOUT THE RESEARCH SEMINAR:
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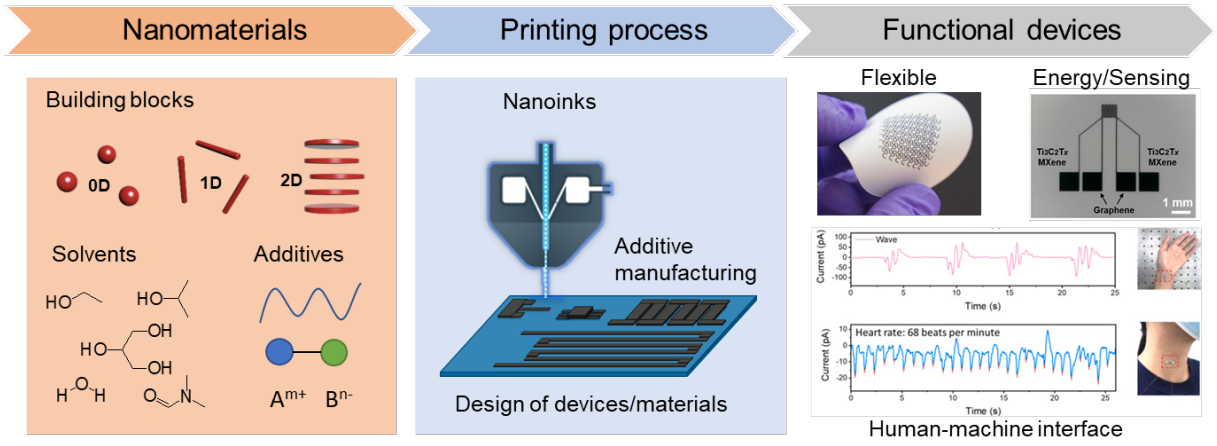
Title of Presentation:

3D Printing of Colloidal Nanoinks for Next-Generation Functional Materials and Devices

Abstract

3D printing has emerged as a promising tool to directly transform materials into functional structures and devices. In particular, the design freedom of 3D printing enables conventionally difficult material processes at a device level, leading to fast prototyping and scalable manufacturing of next-generation electronics. Despite the recent advances in 3D printable polymers and elastomers, the 3D printing of electronics from nanomaterials remains challenging. A large part of this challenge is dependent on the ability to maintain the processability and performance of ink nanomaterials throughout the entire printing process. In this talk, I will introduce a surface-engineering pathway to enable scalable and sustainable fabrication of colloidal functional nanoinks. To improve the performance of printed electronics, one key shortcoming of conventional ink formulation is the inherent insulating nature of organic additives that hinder and even prevent carrier transport among nanomaterial interfaces. I will show how the concept of surfactant design from organic molecules is expanded to particle systems, where surface-functionalized nanosurfactants can stabilize various colloidal ink systems and promote photoconductance of printed UV sensors (i.e., arising from excitation across the nanosurfactant bandgap). In the second part of my talk, I will describe the multi-material 3D printing approach for materials discovery and optimization. Leveraging aerosol-based mixing and deposition, the presented printing technique demonstrates the on-demand control on the compositional/structural arrangements of nanoscale building blocks. Furthermore, several printing strategies will be showcased, including combinatorial doping, alloying, chemical reaction, and compositional microstructuring. The ability to combine the top-down designing freedom of 3D printing with bottom-up ink formulation of nanomaterials promises the almost infinite possibility of compositionally complex materials and microstructures that are inaccessible from conventional manufacturing approaches, offering a powerful pathway toward the design of next-generation devices for broad applications in energy, sensing, environmental, and healthcare fields.



Short Bio

Minxiang (Glenn) Zeng is currently a research scientist in the Advanced Materials & Energy Laboratory (AMEL) at the University of Notre Dame, where he is developing colloidal ink

formulations and advanced manufacturing techniques for next-generation energy, environmental, and sensing devices. He received his Ph.D. degree in Chemical Engineering from Texas A&M University in 2018, where he studies solution-based manufacturing with an emphasis on fundamental colloidal physics including entropy-driven assembly and surface engineering. He is a recipient of the 2019 Texas A&M Distinguished Graduate Student and “Best Oral Presenter” award in the 2018 EASTMAN-ChEGSA Research Symposium for his mentorship of the undergraduate research team.