Polymer Program

INSTITUTE OF MATERIALS SCIENCE

Seminar: 11:15 am Friday, September 27, 2024

Science 1: Room 1002

Host: Mu-Ping Nieh

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Smart Biodegradable Polymers at Nano and Micro-scales for Medical Application

Abstract: The ability to transform medical materials such as the resorbable surgical suture polymers and natural amino acids, into desired 3D forms/shapes/structures at nano and micro scales with "smart" functions, while sustaining the materials' excellent biocompatibility and biodegradability, provides significant applications in different biomedical fields, ranging from tissue engineering and controlled drug/vaccine-delivery to medical implants. Here, I will present our recent research works to create 3D microstructures of biodegradable polymers for developing single-administration self-boosting vaccine microneedles, and convert the biopolymers into "smart" piezoelectric nanomaterials, which can generate electricity under deformation and vice versa, offering a variety of exciting applications such as the implanted biodegradable force sensors, biodegradable ultrasound transducers, and the self-stimulated tissue engineering scaffolds.

Bio: Dr. Nguyen is an associate professor of Mechanical Engineering, joined with the Biomedical Engineering department at the University of Connecticut (UConn). His research is highly interdisciplinary and at the interface of biomedicine, materials and nano/micro technology. Specifically, his research focuses on the science and technology to transform biodegradable and biocompatible materials (e.g surgical-suture polymers and amino acids) into special forms, shapes, or structures with "smart" functions at nano/micro-scales for diverse applications in vaccine/drug delivery, regenerative engineering and electrical implants. He developed a platform technology, so-called SEAL (StampEd Assembly of polymer Layer) to create 3-dimensional microstructures of biodegradable polymers and advanced the SEAL method to create a novel single-administration self-boosting skin microneedle patch for vaccines and other therapeutics, avoiding all painful and inconvenient injections in the traditional vaccine/drug administration methods. Besides, his research group at UConn has extensively studied biodegradable piezoelectric materials, derived from safe medical polymers and natural amino acids, to develop novel biodegradable implanted force-sensor and ultrasound transducer for monitoring vital intra-organ pressures and delivering medicines through the blood-brain barrier, respectively. The biodegradable piezoelectric materials were also used as a tissue scaffold which can be remotely activated to produce electrical cues for stimulating tissue regeneration. Dr. Nguyen's works have been published in prestigious journals including *Science*, *Science Translational medicine*, *Nature Nanotechnology*, *Nature Communication, Advanced Materials*, *PNAS* etc. and highlighted in major media such as *The New York Times, BBC News, the Guardian, NIH research matter etc.* He was elected as the senior member of National Academy of Inventor - NAI (2024). He is the associate editor of the journal of *Biomaterials* and serving as a standing review member for National Institute of Health (NIH). He received several awards/honors including the Young Investigator Award from the journal of *Biomaterials* (2022), ACell Young Investigator Award (2020), MIT top innovator under 35 for Asia Pacific (2019), NIH Trailblazer Award for Young and Early Investigators (2018), SPIE Rising Researcher Award (2019), Young Investigator Award in Biosciences and Bioengineering of Applied Sciences (2019), and the SME Outstanding Young Manufacturing Engineer Award (2018) etc