NJIT New Jersey Institute of Technology | BME Department of Biomedical Engineering

Graduate Seminar

Dr. Jian Zhang

Postdoctoral Scholar
The Ben May Department for Cancer Research
The University of Chicago

March 3 (Friday)
11:30am - 1:00pm
CKB 303

Development of Drug Delivery and Biosensors using Nano/Micro Technology

Abstract:

Medicines have come a long way, from medicinal plants thousands of years ago to today's various synthetic drugs. However, even today, there are still many people with medical conditions suffer from drug side effects, painful needle-stick insertion, and overwhelming time/money consumption.

Based on understanding of how key molecules or microenvironment changes are involved in diseases, my research vision is to leverage my nano/micro technique for fabricating functional nano/microparticle integrated materials to help solve these biomedical problems.

In this talk, I will present three example projects from my previous research. Each of them tackles the above mentioned problems from a unique angle. Firstly, I will introduce a micro-technology that can deliver transforming growth factor-β (TGFβ) inhibitor at the right time to achieve scarless wound healing. TGFβ signaling exerts pleiotropic effects on wound healing by regulating cell proliferation, migration, extracellular matrix production, and the immune response. Although blocking TGFβ signaling can reduce tissue fibrosis and scarring, systemic inhibition of TGFβ can lead to significant side effects and inhibit wound re-epithelization. The wound dressing material I developed based on an integrated photo-crosslinking strategy and a microcapsule platform with pulsatile release of TGFβ inhibitor can enhance skin wound closure while effectively suppress scar formation. Secondly, a new microneedle monitor based on fluorescent nanodiamond for continuous blood glucose monitoring will be shown. Fluorescent nanodiamond is one of the most photostable fluorophores with superior biocompatibility. When surface functionalized, the fluorescent nanodiamond can integrate with boronic polymer and form a hydrogel, which can produce fluorescent signals in response to environmental glucose concentration. The monitor based on this nanodiamond hydrogel demonstrates remarkable long-term photo and signal stability in vivo. And finally, I will share a Janus nanoparticles platform for lactate-responsive payload release. In this study, I pursue a different strategy to leverage the cancer Warburg Effect and develop a tumor-specific drug delivery system by targeting lactate itself. My results demonstrate superior efficiency and specificity of drug delivery with this platform, and greatly enhanced therapeutic efficacy in animal models. Since one of the most well-known metabolic features of the injured brain is high lactate concentrations in the brain's extracellular fluid, the platform also has the potential to capture the "golden moment" for traumatic brain injury patients when their lives are most likely to be saved.

About the Speaker

Jian Zhang is a postdoctoral scholar in the Ben May Department for Cancer Research at the University of Chicago. He is a translational scientist with a PhD in polymer & biomaterials and 7 years of postdoctoral training in cell biology & life science. His research accomplishments include a timed delayed pulsatile drug delivery system for scarless wound healing, a fluorescent nanodiamond based portable sensor for long-term continuous blood glucose monitoring, multi-responsive nanoparticles for drug delivery, and a novel nano-composite bone scaffold. His work focuses on applying nano/micro technology to address a variety of biomedical problems that play critical roles in human life.