Modulating the Therapeutic Microenvironment using Nanostructured Biomaterials

Drug delivery across epithelial barriers (oral, transdermal, mucosal) remains the preferred route for drug administration. However, therapeutic macromolecular drugs currently under development suffer from poor oral bioavailability, and consequently many of these macromolecules are delivered by injection. A variety of delivery paradigms have been developed, including chemical permeation enhancers, physical disruptors, and mucoadhesive materials, to enable more effective delivery of therapeutic macromolecules across epithelium but clinical utility has been limited thus far. Nanostructured biomaterials may offer potential advantages over conventional drug delivery strategies by enhancing molecular transport and local cellular response. The use of surface nanotopography, coupled to micro and macroscale substrates, may permit enhanced transport of drugs, particularly protein therapeutics. In this talk, I will discuss the effect of nanostructured surfaces on the modulation of tight junction permeability and transport of key therapeutic molecules in vitro and in vivo. I will also discuss how micro and nanostructures can be used to modulate fibrosis and the immune microenvironment, presenting distinct biophysical cues to cells. The effect of geometry and the development of materials that can ultimately enhance therapeutic delivery is important for a broad range of diseases.

This lecture is sponsored by the McCormick School of Engineering, the Departments of Biomedical Engineering, Chemical & Biological Engineering, Materials Science and Engineering, the Simpson Querrey Institute for BioNanotechnology, and the Predoctoral Biotechnology Training Program.