Cell Fabricated and Synthetic Hyaluronan Polymer Brushes for Tissue Regulation and Biomaterials

PATRICK CHANG,[1,2] WENBIN WEI,[1,2] JESSICA FAUBEL,[1,2] REBECCA KEATE,[1,2] ANDRES GARCIA,[2,3] JENNIFER CURTIS[1,2]

[1] *School of Physics, Georgia Institute of Technology*
[2] *Petit H. Parker Institute of Bioengineering and Biosciences*
[3] *School of Mechanical Engineering, Georgia Institute of Technology*

Abstract

In this talk, I will present two stories about our lab's studies of natural and synthetic hyaluronan polymer brushes and their relevance to biological function, disease, and biomaterials applications. The first story focuses on the cell-surface bound polymer brush formed by many cell types – a hyaluronan-rich glycocalyx. Our data demonstrates that this cell-bound polymer brush plays an underappreciated role in mediating cell surface access to nanoparticles and molecules. Further, the data suggests that hyaluronan at the cell substratum can exert a significant repulsive force which mechanically regulates cell adhesion in concert with focal adhesions. This result raises important questions about whether cell integration into tissues is regulated by the orchestration of repulsive and adhesive elements, as opposed to the current paradigm which describes regulation as arising solely from adhesive-type interactions mediated by integrin. In the second story, I will introduce a new class of regenerative polymer brushes and hyaluronan biomaterials, fabricated by a dense ensemble of the enzyme hyaluronan synthase. These brushes are among the thickest reported in the literature, and are biocompatible and biodegradable, stimulus responsive, extremely non-fouling and most uniquely- they can be regenerated after removal. I will briefly introduce the fabrication and characterization of the brushes and discuss future applications.