Translating Molecular Bioengineering from the Lab to the Patient

This talk will highlight recent work from my laboratory that illustrates the clinical translation of molecular bioengineering technologies for point-of-care clinical diagnostics, drug delivery, and regenerative medicine. In the first example, I will describe a point-of-care diagnostic —the D4 assay — that we have developed, in which all reagents are printed and stored on a “non-fouling”—protein and cell resistant—polymer brush. The D4 assay has a speed and sensitivity that is as good or better than commercially available point-of-care tests and is far simpler, cheaper more rugged, and does not require a cold-chain. In the area of drug delivery, I will describe a recombinant fusion of peptide and protein drugs to a thermally sensitive polypeptide that forms an insoluble depot upon subcutaneous injection and provides sustained and tunable release of the drug from the injection site. In the area of tissue engineering/regenerative medicine, I will discuss how we have used ELPs as a template to encode higher order, hierarchical self-assembly into macroscopic biomaterials by modulating the degree of order in these intrinsically disordered polymers, leading to materials that are soluble at room temperature but upon injection subcutaneously —or elsewhere in the body— self-assemble into a physically crosslinked material with interconnected pores. These materials spontaneously vascularize, exhibit minimal inflammation, and show excellent tissue integration, and these properties suggest that they may be useful for regenerative medicine.