UC San Diego
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NanoEngineering

UCSD NANOENGINEERING/CHEMICAL ENGINEERING

SPECIAL SEMINAR

Monday, March 2, 2020
Seminar Presentation: 9:30am – 10:30am
SME room 248

“From ssDNA Synthesis to Antifouling Brushes: Enzymes Enable Living Polymerization Reactions”

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Abstract: The use of DNA as a polymeric building material transcends its function in biology and is exciting in bionanotechnology for applications ranging from biosensing, to diagnostics, and to targeted drug delivery. Hence, the efficient and precise synthesis of high molecular weight DNA materials has become key to advance DNA bionanotechnology. Here, I report on how we exploit a template-independent DNA polymerase —terminal deoxynucleotidyl transferase (TdT)— to catalyze the polymerization of 2’-deoxyribonucleoside 5’-triphosphates (dNTP, monomer) from the 3’-hydroxyl group of an oligodeoxyribonucleotide (initiator). We found that the reaction kinetics follows a “living” chain-growth polycondensation mechanism, and that like in living polymerizations, the molecular weight of the final product is determined by the starting molar ratio of monomer to initiator. Our synthesis approach can incorporate a wide range of unnatural dNTPs into the growing chain which allows us to synthesize multifunctional block- copolymers that can self-assemble into micellar structures for drug delivery applications.
Next, I report on our recent work on polymer brush synthesis. Polymer brush coatings are frequently prepared by radical polymerization, a notoriously oxygen sensitive process. Here, I show that glucose oxidase (GOx), which enzymatically consumes oxygen as it oxidizes glucose, can inexpensively enable surface-initiated atom transfer radical polymerization (ATRP) while open to air. Specifically, we used GoX-assisted ATRP to grow a set of biomedically relevant polymer brushes, including poly(oligo(ethylene glycol) methacrylate) (POEGMA), and poly(sulfobetaine methacrylate) (PSBMA). We tested the antifouling properties of these polymer brush coatings against human blood plasma, and found that coatings prepared with GOx repelled more plasma proteins in all cases than their GOx-free counterparts.

Biosketch: **Stefan Zauscher** is a Professor in Mechanical Engineering and Materials Science at Duke University. He directed the Research Triangle NSF Materials Research Science and Engineering Center. His research interest is broadly focused on understanding and harnessing the fundamental physico-chemical properties of soft materials and phenomena that emerge at the interface between engineered and biological systems. Recent activities include the biosynthesis of inorganic nanoparticles, synthesis of biohybrid mucin mimics, and the development of an all-nucleotide anticancer chemotherapeutic platform.