seminar

SEMTE

Manipulating Ion-Containing Block Copolymer Structure and Function For Gene Therapy Vehicles and Electromechanical Transducers

School for Engineering of Matter, Transport and Energy

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abstract

Ion-containing block copolymers (BCPs) deliver synergistic nanoscale features to optimize performance, and my talk will highlight their application as both electroactive membranes and biomedical therapeutics.

Ion-containing BCPs enable access to microphase-separated nanostructures containing soft, ion-conducting microdomains covalently bound to rigid microdomains that impart mechanical strength. Electromechanical transducers necessitate robust mechanical properties and high ion mobility; however, ion-conducting polymeric systems typically sacrifice ion mobility to maximize mechanical strength or vice versa. Therefore, we designed BCPs through the systematic development of structure-property relationships to optimize the thermomechanical properties and ionic conductivity, which yielded the first successful cationic electromechanical transducer.

New approaches to polymer-based gene therapy are necessary, as the complex demands on polymeric nanocarriers have resulted in modest clinical impact. On one hand, the binding interactions between nucleic acids and cationic polymers must be sufficiently strong to prevent nuclease-mediated degradation, yet on the other hand, weak interactions are necessary to enable nucleic acid release within cells. To address this paradox, we designed and synthesized light-responsive, o-nitrobenzyl-containing cationic BCPs and investigated their potential for nucleic acid encapsulation and triggered release. The resulting BCPs combined PEG with a novel, photo-responsive block to facilitate tunable, salt-stable complexation and light-activated release. This responsive design outlines a new approach to advance non-viral gene packaging.

biosketch

Matthew Green received his B.S. degree in Chemical Engineering and Chemistry from Virginia Tech in 2007. In 2011, he completed his Ph.D. in Chemical Engineering at Virginia Tech working with Prof. Timothy Long. He joined Prof. Thomas Epps', III and Prof. Millicent Sullivan's research groups in Chemical and Biomolecular Engineering at the University of Delaware as a post-doctoral researcher in 2012. Matthew was the recipient of a NSF IGERT in graduate school, and was recently selected as one of eight mentees in the Future Faculty Mentoring Program offered through the Education Division of the AIChE. His research focuses on engineering and designing stimuli-responsive ion-containing block copolymers for gene delivery and electromechanical transducers.

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