Northeastern University
College of Engineering

Wednesday, March 25, 2026 | 108 Snell Engineering Ctr | 12:00 PM

Distinguished Seminar Speaker

Bursting Bubbles, Bio-colloids, and Bilayers

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Abstract. This talk will describe fundamental studies and practical applications of biological colloids in the context of human disease. The talk will begin with endogeneous colloids and how they contribute to disease pathogenesis, including the important roles that microstructural transitions and particle aggregation dynamics play. Specifically, it will be shown how an incomplete transition from hepatic vesicles to bile salt micelles leads to enhanced vesicle aggregation and faster rates of cholesterol nucleation to produce gallstones and how aggregation of low density lipoproteins within the intima contributes to foam cell formation and subsequent atherosclerotic plaques. The talk will then focus on how exogenous biological colloids can be designed to diagnose diseases or treat diseases, or both. Specifically, interactions between ultrasound, phospholipid monolayer-coated gas bubbles, phospholipid bilayer vesicles, and cells will be reviewed with an eye toward diagnostic ultrasonic imaging and ultrasound-induced controlled drug delivery. Microbubble physics, including inertial cavitation and the influence of membrane properties will be reviewed, and a comparison between model predictions and experimental measurements will be made. Noteworthy is the predicted dependence, or lack thereof, of inertial cavitation on area expansion modulus through the variation of PEG molecular weight and mole fraction in the microbubble monolayer coating. The talk will also involve a discussion of nesting microbubbles inside the aqueous core of vesicles and how this significantly increases the inertial cavitation threshold. The talk will conclude with an examination of the role that triglycerides play during the nesting process, how this contributes to encapsulation efficiency, and how this could give rise to novel microbubble architectures going forward.

Biography. Steven Wrenn earned his B.S. in chemical engineering from Virginia Tech in 1991. While an undergraduate, he worked as a co-op for G.E. Plastics (formerly Borg Warner) in Parkersburg, WV. After graduating he worked for three years as a process engineer for Zeneca, Inc. (formerly ICI Americas, Inc.) in New Castle, DE. He then returned to school, earning his Ph.D. in chemical engineering from the University of Delaware in 1999. After graduating from Delaware, he joined the chemical engineering faculty at Drexel University in Philadelphia. In 2006 he became an Alexander von Humboldt research fellow and spent a year at Ruhr University in Bochum, Germany. In 2021 he returned to Virginia Tech to serve his alma mater as Department Head of Chemical Engineering.

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