Physics Colloquium

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Biopolymer Matrices: From Fundamental Questions to Applied Goals?

My laboratory's research on collagen I gels can be framed as a narrative of asking and answering fundamental questions to reach applied goals in biophysical studies and bioengineering applications. One such fundamental question revolves around determining key events in collagen I gelation, with a focus on the nucleation and growth entropically-driven self-assembly of collagen fibrils and subsequent fiber entanglement and network formation. An enhanced understanding of these processes would ideally lead to independent control over local and global protein content and presentation, network structural properties, and gel mechanical properties for use in physiologically relevant but well-controlled biophysical experiments, such as those interrogating signaling processes involved in cell migration in three-dimensional obstacle-strewn environments. The origin and ramifications of strain stiffening in collagen I gels have been a second area of fundamental interest, with enhanced understanding of this process potentially leading to new synthetic materials for tissue engineering as well as to biophysical experiments to interrogate the complex reciprocal mechanical interactions between cells and their local environment. I will highlight the progress and challenges in addressing these fundamental questions surrounding collagen gelation and strain stiffening and the distinct set of challenges that surrounds using the answers to these questions to achieve practical goals. Despite such challenges, I will show how even these non-ideal in vitro biopolymer gels provide opportunities for significant findings in the biophysics of cancer invasion.

Laura Kaufman *graduated summa cum laude from Columbia University in 1997 with a B.A. in Chemistry and English. She earned her Ph.D. in Chemistry in 2002 from the University of California, Berkeley. There, Laura worked on multi-dimensional Raman spectroscopy of simple liquids in the laboratory of Professor Graham R. Fleming. She went on to do postdoctoral work at Harvard University under the guidance of Professors X. Sunney Xie and David A. Weitz, where she used CARS microscopy to study colloidal glasses and cells in gels. Laura has been named a NYSTAR Young Investigator, a Beckman Young Investigator, a Camille and Henry Dreyfus Teacher Scholar, and a Lenfest Distinguished Faculty Member. Her laboratory is highly interdisciplinary and focuses on the dynamics of complex, crowded systems. In particular, the laboratory studies heterogeneous dynamics in supercooled liquids with single molecule microscopy, the mechanical properties and structure of biopolymer gels using rheology and microscopy, and brain and breast cancer cell invasion in tissue approximations of tailored architecture and biochemistry. In addition to research and teaching, Laura likes to read, run, and spend time with her two young children and one old dog.*

Thursday, March 23 at 4:10PM
in Lewis Lab. 316

Refreshments at 3:45PM