Laura Kaufman

Columbia University

Vignettes on Crowding: Cells, Gels, and Glasses

Abstract: The Kaufman group uses optical microscopy to investigate complex systems in which interesting dynamics emerge from crowding in the system: areas of particular interest include supercooled liquids, biopolymer gels, and cell migration through densely packed environs. In supercooled liquids, one key unanswered question is how molecular crowding leads to the very unusual heterogeneous dynamics displayed by these systems, where a given molecule may exhibit rotational and translational motion orders of magnitude faster than its neighbors. We study these systems with single molecule microscopy, as such experiments are the only ones capable of directly interrogating the length and time scales of interest in these systems. Many of the interesting and poorly understood dynamics in supercooled liquids also appear in systems that undergo a gel transition. Biopolymers that undergo such transitions *in vivo* and *in vitro* include actin and collagen, two molecules crucial in basic cell and tissue function, respectively. We use novel approaches to study this transition as well as to design and characterize biopolymer gels. Enhanced understanding of the connection between structure and mechanical properties in collagen gels has allowed advances toward our applied goal of creating collagen environments in which structure can be tuned independent of other variables. Production of such gels then allows assessment of how topological crowding, mechanical properties, and biochemical composition independently affect cell migration, and in particular cancer cell invasion, in three-dimensional environments.