Center for Fluid Mechanics, Division of Applied Mathematics
Fluids, Thermal and Chemical Processes Group, School of Engineering
Joint Seminar Series

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m^2 Rheology to Rapidly Screen Therapeutic Hydrogelators

Continued advances in structural biology and the quantitative understanding of biomacromolecular and cellular behavior have created new opportunities for the rational design of bioactive hydrogel materials. Hydrogel structure, rheology, epitope presentation, growth factor sequestration, and transient properties such as erosion have emerged as key design parameters in tissue scaffold, wound healing and drug delivery applications. Our recent collaborative efforts have focused on engineering new erodible materials based on the interactions of proteins and polysaccharides of relevance in the extracellular matrix (ECM). These matrices are capable of sequestering and controllably delivering high percentages of active growth factors. In order to identify target material properties in a large composition space, we use high-throughput microrheology based on multiple particle tracking microrheology [1] and a microfluidic device capable of producing hundreds of microliter-volume samples, each with a unique composition. This approach is based on a recent understanding of covalent and non-covalent polymer gel microrheology as these materials pass through the liquid-solid transition [2]. Such "m^2rheology" conserves both material and time, and is particularly suited to characterizing emerging materials during their development and before significant production scale-up.

[1] K. M. Schultz et al., Soft Matter, 5:740–742, 2009; Macromolecules, 42:5310–5316, 2009.
[2] T. H. Larsen and E. M. Furst. Phys. Rev. Lett., 100:146001, 2008.

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