578b Microrheological Probes for Amphiphilic Block-Co-Polypeptide Self-Assemblies

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Biological systems have evolved the ability to assemble a variety of molecules into functional architectures that can specifically interact with cellular ligands in complex environments. Mimicking these intra- and inter-molecular characteristics with the self-assembly of amphiphilic block-co-polypeptides allows one to access the specificity associated with proteins at a variety of length-scales.

The resulting assembled structures can be evaluated with rheological techniques, where changes in aggregate morphology yield distinct changes in the visco-elastic response of the materials. We use the combination of conventional macro-rheological measurements and microrheology to examine assembly and specific binding of these polymers. First, inert PEG-functionalized microrheological probes are applied to examine the storage and loss moduli, as well as the pore size and connectivity of the peptide-base gels. Second, integrin-functionalized microrheological probes are applied to measure the presentation of the RGD from the block-co-polypeptide assembly interface, where binding behavior of the probes are correlated to the kinetics and specific interaction energy of the gel-network.

These self-assembled peptide-based materials have potential to be next-generation artificial tissue scaffolds, combining the presentation cell-specific binding motifs with large pore sizes to controllably encapsulate cells. Rheological characteristics offer a useful tool to study the features that are germane to the design and function of biological molecules, and the precise measurement of a system's viscoelastic storage and loss moduli can help to define the morphology and connectivity of complex fluids at the molecular level.