

Microrheology for Soft Matter and Active Materials

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In contrast to conventional rheology that probes the mechanical properties of materials by making contact with the materials at their exterior boundaries, microrheology probes materials from their interior. Instead of studying properties of the materials as whole, microrheology focuses on the regions where the probes are located. This lecture will introduce experimental approaches used for studying microrheology of soft matters, including the passive and active methods. We will learn how both methods, both use microscopic probes embedded in the sample, measure viscoelastic properties of the materials. Specifically, how Brownian motions of the particles are used to calculate the compliance of the matter from the fluctuation-dissipation relationship. We will also learn how the mechanical response-function, i.e., the frequency-dependent elastic modulus and loss modulus, is determined from the forced harmonic oscillation of the probe particles. We will also learn how, the active and passive methods, when combined, can be used to quantify non-thermal mechanical activities, such as those produced by motor proteins, in living biological cells.