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Role of slip between a probe particle and a gel in microrheology
HENRY FU, VIVEK SHENOY, THOMAS POWERS, Brown University — In the technique of microrheology, rheological information is deduced from the behavior of microscopic probe particles under thermal or active forcing. Microrheology requires knowledge of the force felt by a probe particle in response to displacements, which we investigate for a spherical particle using the two-fluid model. The gel is represented by a polymer network coupled to a surrounding solvent via a drag force. We obtain an analytic solution for the response function in the limit of small volume fraction of the polymer network, and neglecting inertial effects. We use no-slip boundary conditions for the solvent at the surface of the sphere. The boundary condition for the network at the surface of the sphere is a kinetic friction law specifying the tangential stress. We show that the far field motion and the force on the sphere are controlled by the solvent boundary conditions at high frequency and by the network boundary conditions at low frequency. At low frequencies compression of the network can also affect the force on the sphere. We find the crossover frequencies at which the effects of sliding of the sphere past the polymer network and compression of the gel become important.

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