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Depletion Zone Effects in Active Microrheology Studies of DNA Solutions COLE D. CHAPMAN, DOUGLAS E. SMITH, University of California, San Diego, RAE M. ROBERTSON-ANDERSON, University of San Diego — In active microrheology studies, micron scale spheres are driven through complex fluids while forces imparted on the spheres are measured to determine valuable information about the fluids at the molecular level. However, when a microsphere is dragged through a polymer solution, polymers can amass along its leading surface while leaving an area devoid of polymers in its wake (depletion zone). Depletion zone effects can complicate the interpretation of the measured force, prohibiting standard continuum limit methods for analyzing microrheology data. Here, we examine the depletion zone created by dragging microspheres embedded within a network of DNA (a model polymer). Using dual-force optical tweezers, parallel microspheres are driven axially through a DNA solution, while measuring the force imparted on the individual microspheres. Thus, we are able to explore the effective 'wake' created by the leading microsphere via the response of the lagging microsphere and its dependence on a variety of parameters, such as solution concentration, distance traveled, and driving rate. This technique is combined with single-molecule fluorescence microscopy, allowing for simultaneous visualization of the deformation of the individual DNA molecules surrounding the driven microspheres.

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