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Constant Tip-Surface Distance with Atomic Force Microscopy via Quality Factor Feedback LIN FAN, DANIEL POTTER, TODD SULCHEK, Georgia Institute of Technology — The atomic force microscope (AFM) is a powerful and widely used instrument to image topography and measure forces at the micrometer and nanometer length scale. Because of the high degree of operating accuracy required of the instrument, small thermal and mechanical drifts of the cantilever and piezoactuator systems hamper measurements as the AFM tip drifts spatially relative to the sample surface. To compensate for the drift, we control the tip-surface distance by monitoring the cantilever quality factor (Q) in a closed loop. Brownian thermal fluctuations provide sufficient actuation to accurately determine cantilever Q by fitting the thermal noise spectrum to a Lorentzian function. We show that the cantilever damping is sufficiently affected by the tip-surface distance so that the tip position of soft cantilevers can be maintained within 70 nm of a setpoint in air and within 3 nm in water with 95 percent reliability. Utilizing this method to hover the tip above a sample surface, we have the capability to study sensitive interactions at the nanometer length scale over long periods of time.

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