DETERMINATION OF ELASTIC MODULI OF SOFT, THIN SAMPLES USING THE ATOMIC FORCE MICROSCOPE

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The atomic force microscope (AFM) is increasingly becoming a powerful tool for measuring elastic moduli at microscopic scales. When it comes to soft biological materials, however, two problems have been identified with the experimental method and the mathematical models that are widely used for material parameter extraction. The first is associated with the use of sharp cantilever tips, which, even for very small forces, induce local strains that far exceed the linear material regime. Also, the usual theoretical assumption of semi-infinite sample thickness often introduces significant errors because thin samples on rigid substrates appear stiffer than they really are. Here, we propose that microspheres attached to the cantilever tips, which provide well-defined contact surfaces can ensure material linearity, and we establish the force range for which linear elasticity theories are applicable. We also develop simple to use corrections to the standard Hertzian contact solution to correct for the finite thickness of samples. Both slipping and bonding of the sample to a rigid substrate are considered. The theoretical and experimental results are being verified by macroscopic measurements using gels.