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A Hybrid Molecular/continuum Analysis of IFM Experiments on a Self-assembled Monolayer

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Polymeric self-assembled monolayers (SAMs) are used to minimize stiction in MEMs devices and control adhesion in composites. Nanomechanical models of friction, adhesion and fracture require the properties of these SAMs. This paper examines the use of molecular dynamics and continuum analyses and a novel scanning probe microscope for this purpose. An interfacial force microscope (IFM) is used to probe self-assembled monolayers of octadeciletrichlorosilane (OTS) on silicon. Its unique self-balancing force sensor allows the full attractive and repulsive portions of the force–displacement response of the tip/surface interactions to be obtained. The measured force profiles are used judge the validity of linear and nonlinear elastic models of the OTS behaviour in continuum analyses that include surface interactions. The nonlinear behavior is motivated by molecular dynamics analyses of simple stress states. The linear elastic analyses yield high Young's moduli, corresponding to the high degree of order. The nonlinear analysis is more promising.

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