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Frictional aging of a monolayer-coated micromachined actuator

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Friction is a critical issue for micromachines, often limiting their usefulness. Thus far, studies of micromachines have measured static coefficients of friction and in a few cases coefficients of dynamic friction. Using our high performance nanotractor actuator, we have found that there is no unique static friction coefficient. Instead, we find that the coefficient varies both with time and with loading conditions. Additionally, we have observed a bifurcation in behavior when transitioning to sliding. Depending on the applied loads, either frictional creep or inertial sliding occurs. These behaviors are well described within the rate-state friction methodology, developed out of observations on rock-rock friction and applied to the understanding of earthquakes. We believe our observed effects are due to a vapor deposited monolayer coating and that details of our monolayer lead to a new effect not observed previously in rate-state friction, namely suppression of frictional aging at high contact pressures. Typical asperity radii of curvature in our system are from 20 to 100 nm , very similar to those of AFM tips. Therefore, these measurements may present an opportunity to relate AFM and FFM experiments to the performance of real micromachine devices.

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