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Understanding the frictional response of organic monolayer coatings using Atomic Force Microscopy ERIN E. FLATER, Department of Engineering Physics, University of Wisconsin-Madison, ALEX D. CORWIN, MAARTEN P. DE BOER, Department of Reliability Physics, Sandia National Laboratories, ROBERT W. CARPICK, Department of Engineering Physics, University of Wisconsin-Madison — Friction and wear are yet to be fundamentally understood, yet they can be major limiting factors for applications including microelectromechanical systems (MEMS). We use atomic force microscopy to determine frictional constitutive relations for nanoscale contacts designed to represent the asperities in MEMS. Quantitative measurements of friction and contact stiffness are performed using SiO_2- and organic monolayer-functionalized tips on organic monolayer-functionalized silicon. Using octadecyltrichrolosilane, octadecene, and perfluorinated monolayers, we find that friction depends on the type of molecule, its packing density, and the surface attachment chemistry. We also find that fluorination increases friction, as in MEMS, and that molecular transfer to the SiO_2 tip causes large variation in the measurements. With monolayer-coated tips, this variation, as well as the overall friction and adhesion, are significantly reduced.

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