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Effect of Adsorbed Films on Nanoscale Mechanical Contacts SHENGFENG CHENG, Department of Physics and Astronomy, Johns Hopkins University, BINQUAN LUAN, IBM T. J. Watson Research Center, MARK ROBBINS, Department of Physics and Astronomy, Johns Hopkins University — For surfaces exposed to ambient air, the presence of adsorbed molecules cannot generally be avoided. Molecular simulations are presented which show that the compliance of these adsorbed films can have a profound effect on the mechanical behavior of contacts. An adsorbed film of short chain molecules is equilibrated on a flat, elastic substrate. The film is then contacted by a non-adhesive spherical tip. The atomic scale structure of the tip is varied from amorphous to crystalline, since this has a substantial effect on contacts with clean substrates. Including adsorbed molecules reduces sensitivity to tip geometry, but introduces new effects. One is that the contact region is broadened dramatically, with measured contact radii increased from predictions of continuum theory by a constant shift. The variation of tip displacement and substrate deformation with normal load show a crossover between two regimes. At small loads, the effective elastic modulus is set by the soft adsorbed film, while at large loads the modulus is that of the substrate. Variations in friction with tip geometry are much smaller than for bare substrates and the friction rises linearly with load in almost all cases.

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