

Abstract Submitted
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Scale and Stiffness Dependence of Static Friction on Amorphous Surfaces¹ JOSEPH MONTI, Johns Hopkins University, TRISTAN SHARP, University of Pennsylvania, MARK ROBBINS, Johns Hopkins University — Understanding the role that surface structure plays in determining friction at the interface of elastic solids is critical to the development of more efficient small scale mechanical devices and for extracting results from scanning probe microscopy experiments that rely on continuum predictions. Disagreement with continuum contact mechanics is expected at small length scales where atomic discreteness becomes important. We employ molecular simulation techniques to investigate the nature of contact at the atomic scale and to study the origin of frictional effects emerging from interatomic interactions. We focus on amorphous asperities to model realistic probing instruments with contact regions up to a micrometer across and tip radii orders of magnitude larger. The disordered composition of the interface leads to vanishing friction in the large contact limit for stiff surfaces because each atom experiences local lateral forces with random phase. The static friction coefficient scales with the number of contacting atoms N_c as $1/\sqrt{N_c}$. Sufficiently weakening the lateral stiffness of the crystal compared to the characteristic stresses in the contact generates a transition to a regime with saturated average shear stress that is independent of contact size.

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