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Single-asperity friction during quasi-static sliding TRISTAN SHARP, Johns Hopkins University, LARS PASTEWKA, Karlsruhe Institute of Technology, MARK ROBBINS, Johns Hopkins University — The static friction of an asperity is investigated using atomic-scale simulations. We explore scale effects by varying the sphere radius R and the contact radius a from nanometers to micrometers. We first consider commensurate contact between bare lattices with repulsive interactions across the interface. In small contacts, all contacting atoms move coherently and the friction coefficient μ is independent of contact radius and load. In larger contacts, interfacial slip is mediated by localized dislocations, and the static friction coefficient $\mu \sim (\mathrm{Ra_0/a^2})^{2/3}$, where $\mathrm{a_0}$ is the nearest-neighbor spacing. In very large contacts μ stops decreasing and begins to increase with a, at fixed R. The results are in sharp contrast to Cattaneo-Mindlin continuum theory where μ is independent of contact size. Separate simulations are performed to connect the results to the dislocation-based models of contact-size effects due to Hurtado and Kim, and Gao, which assume adhesive interactions between surfaces and find $\mu \sim (\mathrm{a_0/a})^{1/2}$. Simulations for incommensurate contacts show a transition from superlubricity for rigid contacts to a finite friction associated with the Peierls stress in very large contacts. Support from: DMR-1006805; NSF IGERT-0801471; OCI-0963185; CMMI-0923018

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