ABSTRACT

Tribological Interfaces Studied by an Analytical Dislocation Model and *In-situ* Transmission Electron Microscopy

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Fundamental investigations on the origins of friction at the nanoscale were carried out using both theoretical and experimental approaches. A model was developed that analytically solves for friction by the motion of dislocations at atomically flat crystalline interfaces. It combines known concepts from dislocation drag, grain boundary theory, and contact mechanics into a single model which accurately predicts a wide range of friction phenomena, including static and kinetic friction, friction anisotropy, transfer layers and velocity dependence. In addition, values for friction coefficients calculated by inputting only basic materials constants yield reasonable agreement with comparable ultrahigh vacuum friction results.

To test the consequences of the theory, friction anisotropy measurements between single crystal NaCl and $SrTiO_3$ surfaces by pin-on-disk and nanoindentation techniques were conducted, and shown to influence friction by an upper bound of ten percent fluctuation in ambient conditions.