ATOMIC-SCALE FRICTION OF GOLD AND COPPER IN PERCHLORIC ACID

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With the advent of nanotechnology, and more specifically nanomechanical devices, the scaling of friction down to the nanoscopic scale carries significant technological importance. Laws of friction breakdown on such scales because of the dominance of single asperity contacts rather than an ensemble average of them. Nanotribology aims to explain this phenomenon.

In this study, a home-built friction force microscope was used to measure tribological differences between two metal surfaces in a solution of perchloric acid. Electrochemical control of the Au(111) sample allowed to quickly and reversibly switch the surface from copper to gold via an underpotential deposition (UPD) process. The sustained stick-slip imaging of both surfaces confirms the switch by the change in lattice constant. Ramping up and down the normal load (while continuously alternating between both surfaces) yields reversible plots demonstrating the non-linear behavior of friction at such scales. More importantly, friction contrast between gold and copper is consistent throughout the many experiments performed using different AFM tips.

Keywords: Friction, atomic force microscope, stick-slip, copper UPD, gold.