O 38: Poster Session III: Tribology: Surfaces and nanostructures I

Time: Tuesday 10:30–12:30 Location: P

O 38.1 Tue 10:30 P

Thermal Activation of Nanoscale Wear — Wen Wang[1,2], •Dirk Dietzel[1], and Andre Schirmeisen[1] — [1]Institute of Applied Physic, University of Giessen, 35392 Giessen, Germany — [2]School of Mechanical Engineering, Southwest Jiaotong University, 610031 Chengdu, China

Atomic force microscopy under ultrahigh vacuum conditions was used to study the temperature dependence of nanoscale wear occurring on freshly cleaved NaCl (001) and KBr (001) single crystals during continuous line scanning. Independent of the material, we observe non-monotonous wear-rates as a function of temperature, where a distinct transition between two regimes can be correlated to the onset of quasi-periodic ripple formation at higher temperatures. We find that a thermally activated bond breaking model quantitatively fully describes the wear rates in the low temperature regime and can also be applied to the high temperature regime once the alternating structure of mounds and troughs is accurately considered. Based on this agreement with Arrhenius kinetics over the whole temperature range, also the velocity dependence of the wear rate can be explained, where the amount of wear only depends on the overall scan length but is independent of sliding velocity.

O 38.2 Tue 10:30 P

Temperature dependence of friction anisotropy on crystalline materials — •Jennifer Konrad, Dirk Dietzel, and Andre Schirmeisen — Institute of Applied Physics, University of Giessen, 35392 Giessen, Germany

On the nanoscale, the dependence of the friction force on the sliding direction is a well-known phenomenon. This anisotropy occurs as a consequence of the surface structure and is related to different energy barrier heights along different directions of the sample surface. If the sample temperature is varied, the friction force as deduced from the thermally activated Prandtl Tomlinson model is expected to change, with direct influence on the stability of the different sliding directions. In this work, the directional friction force is now analyzed under UHV conditions as a function of temperature on different crystalline materials. Our results show that the both the absolute friction and the anisotropy are not only influenced by temperature itself but also reflect temperature dependent wear effects which ultimately eliminate any frictional anisotropy.

O 38.3 Tue 10:30 P

Frictional Behavior of Antimony Nanoparticles on HOPG at Elevated Temperatures — •Ebru Cihan, Dirk Dietzel, and Andre Schirmeisen — Justus-Liebig University Giessen Institute of Applied Physics 35392 Giessen, Germany

Structural Lubricity describes an effect leading to almost vanishing friction for the case of incommensurate interfaces. But although very low, friction still depends on the exact interface conditions, where especially relaxations between substrate and slider can lead to a dynamic enhancement of the effective energy barrier for lateral motion. Here, we present a tribological study of antimony nanoparticles sliding on highly oriented pyrolytic graphite (HOPG) at elevated temperatures. The high temperatures of up to several 100°C are used to drive the structural relaxation of nanoparticles on the substrate and the corresponding effects of contact aging are analyzed by both static and sliding friction and their respective contact area dependence. In addition, our experimental set-up should even allow to approach temperatures where sublimation of the antimony sets in and fundamentally changed interface conditions can be expected.

O 38.4 Tue 10:30 P

On-surface synthesis and mechanical stabilization of class 1 atropoisomers — •Philipp D'Astolfo[1], Guilherme de Vilhena[1], Carl Drechsel[1], Jung-Ching Liu[1], Xunshan Liu[2], Silvio Decurtins[2], Shi-Xia Liu[2], Rémy Pawlak[1], and Ernst Meyer[1] — [1]Department of Physics, University of Basel, Basel, Switzerland — [2]Department of Chemistry and Biochemistry, University of Bern, Bern, Switzerland

The torsion and rotation about single carbon-carbon bonds is a natural process that is ever-present in Chemistry- and Surface-Sciences. Due to their small magnitude, measurements of force-induced rotational changes between units of a long polymeric chain have proven difficult until now. To shed light on these processes, we synthesized sterically frustrated asymmetric cyclopentaaceanthrylene-polymers on a gold surface and performed lifting- and redeposition experiments using atomic force microscopy (AFM) at 4.8K. We detected repeating jumps in the frequency shift signal related to successive unit detachments of the poly-aceanthrylene units vertically lifted from the Au(111) surface. After performing a lifting experiment, we also redeposited the polymer on the surface while preserving the distinct bond-motif. Molecular dynamic (MD) simulations of the lifting- and redeposition experiments with different tethering of one end, ranging from hard anchored to slightly bonded and free ends, provide an atomistic understanding of the experimentally observed molecular anchoring on the peeling process and shed further light on the stabilization mechanism of sterically frustrated polymers.