O 20: Tribology: Surfaces and Nanostructures

Time: Monday 17:00–19:30 Location: Poster A

O 20.1 Mon 17:00 Poster A

Preparation of structurally lubricated crystalline Au nanoparticles on HOPG for investigations on the shape and orientation dependence of sliding friction — •Felix Hartmuth, Matthias Vorholzer, Dirk Dietzel und André Schirmeisen — Institute of Applied Physics, Justus Liebig University Giessen, Germany

The widely acknowledged fundamental concept of structural lubricity explains the phenomenon of unusually low friction between two clean, rigid, and atomically flat surfaces with a structural surface mismatch that occurs due to incommensurate lattice parameters with regard to the sliding direction. Recent experiments and theoretical studies on structurally lubricated nanoparticles imply that besides the general lattice structure, the particle shape and orientation are also crucial key factors for the determination of sliding friction [1][2]. Since slightest particle rotation can already influence the interfacial friction, validating these concepts requires well defined nanoparticles and high-precision manipulation schemes. Therefore an improved manipulation procedure that allows in situ switching between FM NC-AFM and contact AFM has been set-up. First results obtained using gold nanoparticles on HOPG show that friction does indeed sensitively depend on the particle orientation. Further analysis will concentrate mainly on the switch in and out of pseudo-commensurate orientations.

[1] Dietzel et al., Phys. Rev. Lett. 111 (2013)
[2] de Wijn et al., Phys. Rev. B 86 (2012)

O 20.2 Mon 17:00 Poster A

Surface oxidation of metallic glass surfaces and its effect on nanotribology — •Kai Rittgen[1,2], Arnaud Caron[3], and Roland Bennewitz[1,2] — [1]INM Leibniz-Institute for New Materials, Campus D2.2, 66123 Saarbrücken, Germany — [2]Department of Experimental Physics, University of Saarbrücken, 66123 Saarbrücken, Germany — [3]Korea University of Technology and Education, Department of Energy, Materials and Chemical Engineering, Chungcheongnam-do, 31253 Republic of Korea

Owing to their high strength and hardness metallic glasses have been recognized as potential materials with enhanced wear resistance for tribological applications. While metallic glasses are prone to oxidation, the formation of surface oxide and its impact on tribological properties has been scarcely investigated. In this work we use a correlative approach to determine the influence of surface structure and chemistry on the friction and wear of metallic glass surfaces. Surface structural properties of several different metallic glasses are investigated by AFM in ultra high vacuum after Ar-sputtering and controlled oxidation treatments. Surface oxides are further characterized by SEM, TEM, and XPS. The tribological response of metallic glass surfaces with and without oxide layer is determined by AFM- and nano-scratching in air and in ultra high vacuum. Sputtered and oxidized surfaces of metallic glasses and their crystalline counterparts were compared to determine the relevant physical processes in wear mechanisms.

O 20.3 Mon 17:00 Poster A

Study of Nano Particle Interaction Force of Various Material Systems Using Atomic Force Microscopy — •Irina Schrezenmeier[1], Daniel Geiger[1], Clara Wanjura[1], Matthias Roos[2], Eugen Foca[2], and Othmar Marti[1] — [1]Institute of Experimental Physics, Ulm University — [2]Cleaning Technology Analytics, Carl Zeiss SMT GmbH

The use of nano particles in todays applications and the understanding of their characteristics is of utmost scientific and technological interest. One of these characteristics that needs further attention is the interaction force of nano particles with different substrates. We found that the interaction force of silica particles on silicon substrate shows aging phenomena. The force increases with time and parameters like humidity and temperature influence it as well. The aim of this work is to extend the measurements to the interaction force of various material combinations, such as aluminium particles on aluminium substrates, as well as combinations of aluminium with silica particles and silicon substrates. Further it is investigated if the roughness of the substrate's surface has an influence on the interaction force of the particle to this surface. Measuring this force is done by lateral atomic force microscopy (AFM). Thereby the particle is moved in contact mode AFM, where the torsion of the cantilever gives the force excerted on the particle. The trajectory of the particle is then recorded by imaging the sample in tapping mode AFM before and after the displacement.

O 20.4 Mon 17:00 Poster A

Energy Dissipation Mechanisms in Layered Structures — •Dilek Yildiz, Marcin Kisiel, and Ernst Meyer — Universität Basel

Bodies in relative motion separated by few nanometers gap experiences a tiny friction force. Although nature of non-contact friction is not fully understood yet, it can be measured by highly sensitive cantilever oscillating like a tiny pendulum over the surface. We investigate non-contact friction between Atomic Force Microscope (AFM) tip and the surface of TaS2 and Highly Oriented Pyrolytic Graphite (HOPG) crystals. Both samples are layered crystals with weak interaction between the layers. Yet, the origin of dissipation due to tip - sample interaction is different. While electrostatic type of dissipation is observed to be dominant on TaS2 surface, this type of dissipation is absent on HOPG surface. Interest of this study is to observe frictional response of TaS2 and HOPG to understand the dissipation mechanism in layered structures depending on their surface structures.