O 85: Poster: Tribology and Misc.

Time: Wednesday 18:15–20:30 Location: Poster A

O 85.1 Wed 18:15 Poster A

Frictional Behaviour of Colloidal Spheres Sliding on a Micron-Scale Periodic Substrate — •Alper Özoğul and Enrico Gnecco — Otto Schott Institute of Materials Research (OSIM), Friedrich Schiller University Jena, Löbdergraben 32, 07743 Jena, Germany

The Prandtl-Tomlinson model is widely used to explain the stick-slip nature of nanoscale friction on a crystal surface. Hence, the model is commonly associated with atomic-scale interactions, even though it can be in principle applied to any periodic 'tip-surface' interaction. To study the applicability of the PT model in micron scale, friction force between colloidal spheres of different materials (PMMA, SiO2, Borosilicate glass with Ø ~10 μm) attached to an AFM cantilever and a SiO2 grating consisting of 1.5 μm high slopes with a periodici-ty of 3 μm, is measured. The lateral deflection signals, which corre-spond to the friction force experienced by the spheres, are gathered in a variety of scan conditions (normal force set point, scan speed, sample orientation). As a result, friction force was found to vary up to an order of magnitude between different materials. The stick-slip behaviour characteristic of the PT model was clearly observed only with the PMMA spheres, whereas the friction is largely dominated by the sphere roughness and the surface topography with the other materials. Interestingly, we also observed that in all cases the friction is considerably reduced by contact oscillations superimposed to the scan motion, similarly to atomic-scale friction on crystal surfaces.

O 85.2 Wed 18:15 Poster A

Sonolubrication in Amorphous and Crystalline Materials — •Victor Pfahl[1], Chengfu Ma[2,1], Walter Arnold[3,1], and Konrad Samwer[1] — [1]I. Physikalisches Institut, Universität Göttingen — [2]Department of Precision Machinery and Precision Instrumentation, University of Science and Technology of China — [3]Department of Materials and Materials Technology, Saarland University

We studied sonolubricity, a phenomenon reducing friction between two sliding surfaces by ultrasound. Friction force measurements were performed in an atomic force microscope (AFM) when the tip-surface contact was excited to out-of-plane oscillations oscillations by a transducer or the built-in piezoelectric element in the cantilever holder.

Experiments were carried out near or at the first cantilever contact-resonance. We studied friction on crystalline and amorphous $Pd_{77.5}Cu_6Si_{16.5}$ ribbons, on a silicon wafer at room temperature, and on a $La_{0.6}Sr_{0.4}MnO_3$ thin film at different temperatures. Measurements were carried out varying the cantilever amplitude, the ultrasonic frequency, and the normal static load.

All experimental results display a universal behavior, which can be explained by the non-linearity of the force-distance curve between sample and tip due to the local interaction potential. An analytic function is found, which describes the reduction of friction as a function of the cantilever amplitude.

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O 85.3 Wed 18:15 Poster A

Indication of worn WC/C surface locations of a dry-running twin-screw rotor by the oxygen incorporation in tungsten-related Raman modes — •Henning Moldenhauer[1], Jörg Debus[1], Janina J. Schindler[1], Philipp Waldkirch[1], Sebastian Goeke[2], Andreas Brümmer[3], Dirk Biermann[2], and Manfred Bayer[1] — [1]Experimental Physics 2, TU Dortmund University, 44227 Dortmund, Germany — [2]Institute of Machining Technology, TU Dortmund University, 44227 Dortmund, Germany — [3]Chair of Fluidics, TU Dortmund University, 44227 Dortmund, Germany

Enhancing the lifetime of mechanical parts in industrial processes is a major goal. The key to enhancement is a tribological layer of several tens of namometer thickness that forms at the surface of the mechanical part. These surface changes during wearing have to be understood. This is done by identifying the composition of the tribological layer and determining its spatial distribution by using confocal Raman microscopy. Using this technique we study a tungsten-carbide/carbon (WC/C) surface of a dry-running twin-screw rotor, where worn and untouched locations are compared. Only at worn locations we observe tungsten-oxide Raman modes. Furthermore, several Raman lines are changed significantly in frequency and width, indicating mechanical distortion that occured during the wearing process. Specifically the Raman line at 680 cm^{-1} is enhanced, which corresponds to an incipient oxidation of the WC stretching mode. Given these findings, our results may be exploited to characterize the degree of wear of coated surfaces and to identify signatures of a tribological layer.

O 85.4 Wed 18:15 Poster A

Strahlen aus dem Zentrum von Lampen oder Sternen — •Theresa Ebner[1] und Lena Winterhalter[2] — [1]Ignaz-Günther-Gymnasium Rosenheim — [2]Ignaz-Günther-Gymnasium Rosenheim

Macht man bei Dunkelheit ein Foto von Sternen oder Lampen, sieht man aus dem Zentrum der Lampe oder des Sternes Strahlen kommen. Wodurch dieses Phänomen entsteht, welcher Zusammenhang zwischen Strahlenanzahl und Kamera besteht und warum wir diese Strahlen manchmal auch nur mit dem bloßen Auge sehen kann, habe ich erforscht und versucht zu erklären.

O 85.5 Wed 18:15 Poster A

Writing information in a self-assembled template of tetraphenylmethane derivatives using a scanning tunneling microscope — •Timo Frauhammer[1], Marcin Lindner[2], Michal Valasek[2], Lukas Gerhard[2], Marcel Mayor[2,3], and Wulf Wulfhekel[1,2] — [1]Physikalisches Institut, Karlsruhe Institute of Technology, Germany — [2]Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany — [3]Department of Chemistry, University of Basel, Switzerland

A self-assembled template of tetraphenylmethane derivatives adsorbed on a Au(111) surface, that exhibits a periodic arrangement of acetyl groups sticking out of the molecular film, is presented. By using the tip of a STM, these acetyl groups can be removed in a spatially controlled way without significantly affecting the remaining molecular assembly. The chemically modified molecules can be distinguished from the non-modified ones such that information can be engraved in the molecular film. The mesh size of this pattern can be tailored by varying the length of the molecular spacer, which enables writing and reading information on the nanoscale with variable letter sizes. Moreover, room temperature measurements indicate that such written structures could even persist room temperature.

O 85.6 Wed 18:15 Poster A

Optical properties of laser-excited metals in strong nonequilibrium — •Pascal D. Ndione[1], Sebastian T. Weber[1], Dirk O. Gericke[2], and Baerbel Rethfeld[1] — [1]Department of Physics and OPTIMAS Research Center, Technische Universitaet Kaiserslautern, 67653 Kaiserslautern, Germany — [2]Centre for Fusion, Space and Astrophysics, Department of Physics, University of Warwick, Coventry CV4 7AL, United Kingdom

Light-matter interactions in the femtosecond regime are of great importance for both our fundamental understanding and applications. The modification of optical properties is a key feature as reflectivity or transmissivity carry many informations about the correlated many body system. Short lasers pulses induce nonequilibrium in metals due to absorption of the photons' energy by the free electrons. On a time scale of a few tens to hundreds of femtoseconds after laser irradiation, the electrons thermalize to a Fermi distribution at an elevated temperature. We present here a model which keeps track of the band's occupation in metals triggered with optical photons. In addition, different approximations of the dielectric function are compared for metals driven far from equilibrium.

O 85.7 Wed 18:15 Poster A

Simulation of STM images and spectroscopy of molecules on metal surfaces: DFTB+ computational platform — •Seddigheh Nikipar[1], Dmitry A. Ryndyk[1,2], Bálint Aradi[2], Francesca Moresco[1], Gianaurelio Cuniberti[1], and Thomas Frauenheim[2] — [1]Institute for Materials Science and Center for Advancing Electronics Dresden, TU Dresden, Dresden, Germany — [2]Bremen Center for Computational Materials Science, Department of Physics, Universität Bremen, Bremen, Germany

We developed a theoretical and computational approach for simula-

tions of STM images and spectroscopy, in particular of molecules on metal surfaces. We employed the DFT based atomistic tight-binding model (DFTB approach) combined with the Green function technique, which offers a framework to consider a tip, molecule and surface as one integrated system and taking into account the tip geometry. Besides, it captures the interference and interaction effects. This new computational approach can be applied for the investigation of finite-voltage effects and describe the higher molecular transport states. It allows to calculate the tunneling current between a tip and a molecule more precisely, and simulate quantitatively dI/dV maps and spectroscopy curves. We developed the extension of the DFTB+ computational package (dftbplus.org), which makes possible and convenient calculations for large-scale molecular nanosystems on metall surfaces. Our approach is quite fast due to the DFTB approximation and the effective MPI parallelization. The DFTB+ is free software and can be used at HPC clusters.

O 85.8 Wed 18:15 Poster A

simulation of surface assembly and diffusion — •ZHICHAO HUANG and KAI WU — College of Chemistry and Molecular Engineering, Peking University, Beijing, China

The complexity of the assembly of molecules on the surface makes there is no predictable method of molecular assembly on the surface. When the interaction between the substrate-molecule interaction and the molecular-molecular interaction is weak, the effect of the substrate on the surface assembly structure can be approximately neglected and the molecular-molecular interaction is described using molecular mechanics to achieve the molecular structure Predictive molecular assembly structure. At present, this method has been successfully simulated to obtain trimellitic acid and other organic small molecules of the assembly structure, and experimental observation of the assembly structure consistent.

O 85.9 Wed 18:15 Poster A

Increase of Porosity and Pore Size of Electrodeposited ZnO Films for Using Metal Complexes as Redox Shuttles in Dye-Sensitized Solar Cells — •THI HAI QUYEN NGUYEN, RAFFAEL RUESS, and DERCK SCHLETTWEIN — IAP, JLU Giessen, Germany

Electrodeposited ZnO is an attractive alternative for the commonly used TiO_2 in dye-sensitized solar cells (DSSCs). Pores in such ZnO are typically narrow, making it difficult to use metal complexes as redox shuttles which worked well in TiO_2-based DSSCs. The present work is dedicated to an optimization of the porosity and pore size of ZnO. Porous ZnO films were prepared by electrodeposition in the presence of different structure directing agents (SDA) such as Eosin Y. The influence of the deposition time and the SDA-concentration was analysed. Furthermore, the combination of Eosin Y with other SDA was investigated. The films were studied by SEM, XRD, confocal Laser microscopy and profilometry. The internal surface of the films was determined by gas sorption and by electrochemical impedance spectroscopy. Sample porosity was determined from the amount of Zn in the films allowing to estimate the average pore size in the films. A combination of Eosin Y with a substituted derivative as SDA led to porous ZnO films with high stability and larger pore size compared to films prepared with Eosin Y only. Porous ZnO films could be obtained at less negative deposition potentials allowing increased control of growth parameters. The success of the present work was proven by photovoltaic characterization of test cells based on these new films providing easier diffusion of the large complexes through the ZnO pore structure.