

## CPP 74: Tribology: Surfaces and Nanostructures (joint session O/CPP)

Time: Wednesday 15:00–16:00

Location: GER 37

CPP 74.1 Wed 15:00 GER 37

**Effect of Environment on Microstructure Evolution and Frictional Behavior of Au-Ni Multilayers** — ●EBRU CIHAN<sup>1,2</sup>, HEIKE STÖRMER<sup>3</sup>, KATHERINE JUNGJOHANN<sup>4</sup>, NICOLAS ARGIBAY<sup>5</sup>, MICHAEL CHANDROSS<sup>5</sup>, and MARTIN DIENWIEBEL<sup>1,6</sup> — <sup>1</sup>Institute for Applied Materials - Computational Materials Science (IAM-CMS), Karlsruhe Institute of Technology (KIT), 76131 Karlsruhe, Germany — <sup>2</sup>Institute of Applied Physics, Justus-Liebig University Giessen, 35392 Giessen, Germany — <sup>3</sup>Laboratory for Electron Microscopy (LEM), Karlsruhe Institute of Technology (KIT), 76131 Karlsruhe, Germany — <sup>4</sup>Center for Integrated Nanotechnologies (CINT), Sandia National Laboratories, 87185 Albuquerque, NM, USA — <sup>5</sup>Material, Physical, and Chemical Sciences Center, Sandia National Laboratories, 87185 Albuquerque, NM, USA — <sup>6</sup>Fraunhofer Institute for Mechanics of Materials (IWM), MicroTribology Center  $\mu$ TC, 79108 Freiburg, Germany

We present results from a systematic investigation of environmental effects on microstructure and frictional behavior of Au-Ni multilayer films of varying interlayer spacing. Multilayer samples were initially analyzed under UHV and it was demonstrated that the interlayer spacing has a strong impact on friction due to the transition in the dominant deformation mechanism near the surface. A newly shear-induced phase, which can be interpreted as an AuNi alloy (60-65 at% Ni in Au) was observed in the tribolayer for thinner samples. Subsequently, experiments were performed in dry-nitrogen and higher friction forces were measured, leading to different microstructure evolution.

CPP 74.2 Wed 15:15 GER 37

**Tuning the friction properties of reconstructed KBr on Ir(111) by intercalating a monolayer of graphene** — ZHAO LIU<sup>1</sup>, ANTOINE HINAUT<sup>1</sup>, THILO GLATZEL<sup>1</sup>, SEBASTIAN SCHERB<sup>1</sup>, JUNYAN ZHANG<sup>2</sup>, and ●ERNST MEYER<sup>1</sup> — <sup>1</sup>Department of Physics, University of Basel, 4056 Basel, Switzerland — <sup>2</sup>State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, 730000 Lanzhou, People's Republic of China

The intercalation of graphene and other 2D materials is an effective approach to alter the structures and properties of the top conductive or insulated layers on metal surface [1]. In this work, the growth of KBr islands on Ir(111) is characterized via non-contact atomic force microscopy and friction force microscopy measurement at room temperature in ultrahigh vacuum. We observed the formation of KBr monolayer with highly corrugated superstructure. These superstructures are due to the adaptation of the KBr atoms to the substrate lattice resulting from a tiny misfit of the KBr islands lattice. The superstructure presents a higher friction force of KBr/Ir(111) compared to the bulk KBr(001) as well [2]. We also show the possibility to tune the friction properties of KBr by intercalating a graphene monolayer. Obviously, the reduced friction force is accompanied by the vanishing of the KBr superstructure, with the observation of the common cubic configuration. It gives another view to increase the critical normal load to maintain the superlubric state at the nano scale.

[1] M. Andersen, et al, Phys. Rev. B, 90 (2014) 155428. [2] C. Wiefierink, et al, Phys. Rev. B, 83 (2011) 235328.

CPP 74.3 Wed 15:30 GER 37

**Stick-slip and surface rippling in plastic and abrasive wear on the nanoscale** — ●ENRICO GNECCO<sup>1</sup>, JANA HENNIG<sup>1</sup>, and JUAN MAZO<sup>2</sup> — <sup>1</sup>Otto Schott Institute of Materials Research, Friedrich Schiller University Jena, Jena, Germany — <sup>2</sup>Department of Condensed Matter Physics, University of Zaragoza, Zaragoza, Spain

The formation of regular surface structures as a result of plastic and abrasive wear processes is a general but scarcely understood phenomenon. Here we will discuss this topic with the examples of polymer [1] and silica glass surfaces [2] scratched by silicon and diamond nano- and microtips respectively. In spite of the different nature of the nanoscopic wear mechanisms, quasi-periodic ripple patterns are formed in both cases. The physical interpretation of the observed structures relies on the time evolution of the friction forces acting in the stick-slip motion of the tip, which is simultaneously indented and elastically pulled along the surfaces in order to scratch them. The geometric shapes of the surface structures as well as their dependence on the scan velocity are consequently reproduced by solving the corresponding equations of motion of the tips in an evolving energy landscape.

[1] J.J. Mazo et al., Phys. Rev. Lett. 122 (2019) 256101 [2] E. Gnecco et al., Phys. Rev. Materials 2 (2018) 115601

CPP 74.4 Wed 15:45 GER 37

**Temperature Scaling of Contact Aging Rates on Amorphous Silica Surfaces** — MATTHIAS VORHOLZER<sup>1</sup>, J. GUILHERME VILHENA<sup>2</sup>, RUBEN PEREZ<sup>3</sup>, ENRICO GNECCO<sup>4</sup>, ●DIRK DIETZEL<sup>1</sup>, and ANDRE SCHIRMEISEN<sup>1</sup> — <sup>1</sup>Institute of Applied Physics, Justus-Liebig-Universität Giessen, 35392 Giessen, Germany — <sup>2</sup>Department of Physics, University of Basel, Klingelbergstrasse 82, 4056 Basel, Switzerland — <sup>3</sup>Departamento de Física Teórica de la Materia Condensada, Universidad Autónoma de Madrid, E-28049 Madrid, Spain — <sup>4</sup>Otto Schott Institute of Materials Research, Friedrich Schiller University Jena, 07742 Jena, Germany

Contact ageing is a fundamental aspect to understand dynamic sliding scenarios with alternating phases of halting and sliding. On the nanoscale, recent experiments showed, that ageing effects can be connected to the formation of interfacial bonds. In this work, we now analyze the temperature dependent bond formation dynamics of silica contacts by measuring the pre-rupture contact stiffness. Using this parameter instead of the seemingly more obvious choice of measuring static friction, we can eliminate all effects related to temperature dependent contact rupture. Our results show logarithmic contact ageing at all temperatures and reveal that the ageing can be described by a temperature dependent slope  $\alpha(T) \propto T$ , which is a characteristic fingerprint of thermal activation, anticipated both by analytical calculations and MD-simulation of the bond formation process.