Tribology Focus Topic
Room Hall B - Session TR-TuP

Tribology Focus Topic Poster Session

TR-TuP-1 Measurements of Microscale Friction on Molybdenum Disulfide using an Integrated Quartz Crystal Microbalance and Nanoindentation System, ***Brian Borovsky***, *G McAndrews, R Wieser,* St. Olaf College

We report on experiments investigating the microtribological properties of molybdenum disulfide (MoS2) crystals in the high-speed regime. The sliding speeds obtained are over 1 m/s, corresponding to a practical range for mechanical devices. The contacts formed are approximately 1 µm across or smaller. Measurements are performed with a shear-mode quartz crystal microbalance (QCM) integrated into a nanoindentation system. For each test, a thin MoS2 crystal is adhered to the surface of a gold-coated QCM sensor and mechanically exfoliated. The resonant frequency and quality factor of the modified QCM undergo shifts when a spherical sapphire probe is loaded onto the top surface, allowing the detection of lateral contact forces. The shearing amplitude of the QCM is swept over its available range, with the load held fixed, to observe the transition from partial slip to full slip conditions. The contact area is inferred from the lateral stiffness at low amplitudes. We discuss the observed trends in the friction vs. load and area vs. load curves, as well as the degree to which the frictional shear strength depends on mean applied pressure. These results are compared to existing work on MoS2 for contacts ranging from nanometers to millimeters in size, with the aim of contributing to an improved multiscale understanding of tribological phenomena.

TR-TuP-2 Sliding Wear Behavior of Tool Steel Functionalized with Organic Monolayers Against Aluminum, ***Stephan Prünte***, *D Music,* RWTH Aachen University, Germany*; V Terziyska, C Mitterer,* Montanuniversität Leoben, Austria*; J Schneider,* RWTH Aachen University, Germany

Tool steel surfaces were functionalized with methyl-terminated monolayers of phosphonic acids firmly attached by an intermediate metal-oxide adhesion layer. Their sliding behavior against aluminum was investigated with a ball-on-disc tribometer. Our results show a 3-fold reduction of friction and wear for a densely functionalized tool steel with an intermediate Cu–O adhesion layer compared to a non-functionalized sample due to small interactions between Al and the distal methyl moieties of the monolayer. However, functionalized Fe-O adhesion layers on tool steel failed to improve the sliding behavior against Al. This distinct difference may be rationalized by density functional theory calculations. The molecular monolayer attachment to the Cu-O adhesion layer yields 30% higher bond strength compared to one containing Fe-O. Hence it may be speculated that macroscopic sliding wear behavior is determined by the bond strength between the molecular monolayer attachment and the intermediate metal-oxide adhesion layer (on tool steel).

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