Thursday Afternoon Poster Sessions

Tribology Focus Topic
Room: Hall D - Session TR-ThP

Tribology Poster Session

TR-ThP1 A Vacuum Tribometer to Depict Tribochemical Reactions of Lubricant Additives, ***T. Le Mogne***, *M.I. De Barros-Bouchet, J.M. Martin,* Ecole Centrale de Lyon -LTDS-, France

Today, it is well known that surface chemistry plays a key role in tribology and particularly in additives action under boundary lubrication. Tribochemical reactions are very difficult to predict because many parameters occur simultaneously in the tribological system. To simplify and to understand these phenomena, we have developed an analytical vacuum tribometer dedicated to the simulation of boundary lubrication conditions. A pin-on-flat tribometer is installed in a UHV chamber. Friction tests can be run in a wide range of surrounding partial pressures, typically from 10-8 hPa to atmospheric pressure. To study tribochemical reactions, we can introduce either pure gas or mixtures of gases (or vapours) into the chamber. Both pin and flat counterparts are introduced by a Fast Entry Load-Locks (FEL). The temperature of the flat specimen can be varied from room temperature up to 600°C. Before or after friction experiments, the two samples can be transferred without air exposure by using transfer mechanisms from the tribometry chamber into a preparation chamber and then to the analytical chamber. . This chamber is equipped with a hemispherical spectrometer build by ThermoFisher (220i). X-Ray Photoelectron Spectroscopy (XPS) can be done by using a focused monochromatic X-Ray source. A Field emission electron gun (FEG100) with a spot size lower than 1 µm allows Auger Electron Spectroscopy (AES). Ion gun (EXO5) is used for etching surfaces or for performing depth profiles. Imaging facilities are available by using a video camera for optical image, or a secondary electron detector coupled with the scanned FEG for Secondary Electron Microscopy (SEM). Chemical images can be obtained by Scanning Auger Microscopy (SAM) and XPS images by using dedicated lenses. The chemical reactivity of complex additive molecules with solid surfaces is simulated here by using small molecules with the same chemical function but with a lower molecular weight. Friction experiments are performed under variable partial pressures and at different temperatures. Mixtures of gases can be introduced to study synergistic or antagonist effects between chemical functions of additives. A residual gas analyser is installed on the vacuum chamber in order to control the purity of the gases and also to study any friction-induced outgases. We will present representative results with analyses performed inside and outside wear tracks to show chemical changes induced by tribochemical reactions.

TR-ThP2 ToF-SIMS Investigations of Tribological Layers, ***C. Bruening***, *D. Lipinsky,* University of Muenster, Germany, *S. Neudörfer, G. Poll,* University of Hannover, Germany, *H.F. Arlinghaus*, University of Muenster, Germany

The formation of tribofilms plays a critical role in the longevity of automotive gears. A wide variety of anti-wear and extreme-pressure additives are commercially available for oil modification to build tribological layers and to reduce the friction between different friction partners and enhance the stability of the gear unit. Nevertheless, the behaviour of these layers under different stresses is not well understood. For this study, friction experiments under conditions typical for gear synchronisation were performed. Under standardized conditions on a test bench, rotating synchronisation rings fitted with typical friction linings consisting of brass, scatter sinter or carbon were decelerated on stainless steel cones. As lubricant, commercial gear oil was used, containing zinc dialkyldithiophosphate (ZDDP) and calcium sulfonate acting as AW/EP additive or as detergent, respectively. ToF-SIMS with its high surface sensitivity is well suited for these investigations. It was used to characterize the tribofilms generated by the wear process. Differences in contact pressures, relative velocities of the friction partners, and durations of stress led to the generation of different tribofilms, which is indicated by TOF-SIMS spectra, lateral distribution images, and depth profiles.

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