Tribochemistry of monomolecular lubricant films of ethanolamine oligomers

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Additives are of crucial importance in lubrication technology. Additive molecules physisorbed or chemisorbed onto surfaces form lubricating films fundamentally influencing wear and friction properties of two rubbing surfaces.

Earlier experiments in the macrorange as well. as in the nanorange showed that the three different oligomers of ethanolamine have different lubrication properties on 100Cr6 steel and copper [1], respectively. Ethanolamines act as multidentate ligands on the base of amino, hydroxyl and deprotonated hydroxyl groups of the total formula $NH_{3-n}R_n$ ($R = CH_2CH_2OH$, n = 1 to 3). Mono-, di-and triethanolamine are readily water soluble and are utilised as additives in metalworking fluids. The understanding of the lubrication mechanisms of the additive layer chemisorbed on the specimens investigated yields important information regarding lubrication optimisation concerning the type of additive, type of isomer or oligomer and amount.

The aim of this present study was to find out the influence of oxygen and nitrogen containing substances on tribological behaviour. X-ray photoelectron spectroscopy (XPS) is used to obtain insight into the molecular mechanisms leading to the macroscopic lubricity. Monomolecular lubricant films were deposited onto ultra thin copper films sputtered onto silicon wafers. The surfaces prepared with the three ethanolamine oligomers were investigated by XPS before and after tribological tests, performed with the high frequency reciprocating rig.

X-ray photoelectron spectroscopy investigations were performed using a VG ESCALAB Mk III equipment with a prototype preparation chamber, permitting the transfer of samples from liquid to the analysis chamber under Helium protective gas preventing exposure to ambient conditions [2]. The solution with a concentration of 250 ppm ethanolamine oligomers in double distilled water was transferred into the adsorption device, which is an extension of the spectrometer. The structure of the molecular film is elucidated using angular resolved X-ray photoelectron spectroscopy.

References:

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