diamond

Oil

CASE STUDY

Reducing Wear and Tear with Effective Lubricants

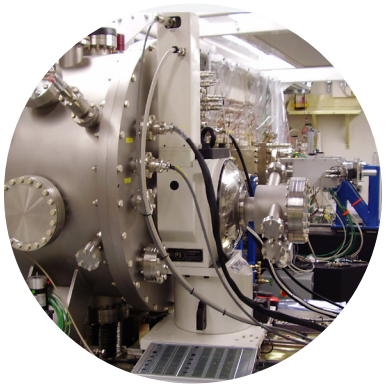
Effective lubrication has a significant impact on a number of applications ranging from human artificial joint implants to energy efficiency of internal combustion engines and the reliability of offshore wind turbine gearboxes.

At low running speeds and high contact pressures the fluid film cannot be maintained and, therefore, effective lubrication is greatly influenced by the presence of chemical additives in the lubricant.

These additives interact with the lubricated surfaces to form nanoscale tribofilms that reduce both material wear and energy losses due to friction. Understanding the mechanisms by which these tribofilms form is essential for development and optimisation of the next generation environmentally friendly effective lubricants, materials and tribological systems.

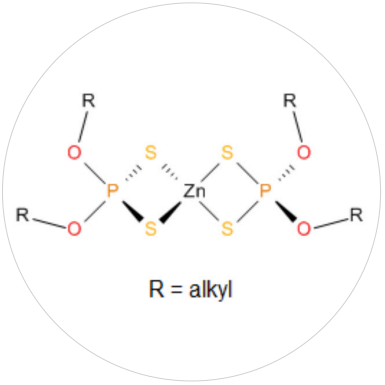
UNIVERSITY OF LEEDS

The Challenge



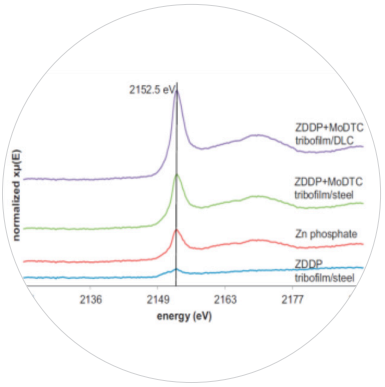
The chemical properties of tribofilms formed from widely used lubricant additives e.g. zinc dialkyl dithio phosphate (ZDDP) and molybdenum dialkyl dithio carbomate (MoDTC) have been studied by various techniques; however, most of the measurements have to be performed in a vacuum environment. This means that the chemical characterisation of tribofilms can only be done post-test, not under the most desirable *in situ* conditions, closer to real operating conditions. Difficulty in accessing the interfaced system while in contact and the nanometre thickness of the sample make real-time measurements extremely challenging.

The Solution



A research group from the University of Leeds teamed up with scientists at Diamond to perform *in situ* XANES studies at the P, S, Zn, Mo K-edges and Mo L-edges throughout the process of ZDDP/MoDTC lubricant thermal film formation. In this set up, the surface sensitivity was achieved by using total external reflection with a penetration depth of 1-10 nm from the surface which was crucial to investigate the lubricant films adsorbed on the surface without the need for a vacuum environment.

The Benefits



The work on I18 demonstrated that valuable information on lubricant film formation kinetics can be obtained with reflection mode XANES methodology in non-vacuum conditions. Lubricant film measurements helped to understand the lubricant film chemistry as a function of testing conditions and substrate greatly enhancing the ability of developing reliable mechanistic models. A detailed understanding of lubricant film formation kinetics will significantly improve the process of designing new engine lubricating oils and coatings for engine applications.

> ""Access to Diamond's I18 has enabled us to study the kinetics of lubricant film formation which are shown to be key for developing mechanistic and numerical models capable of predicting the friction and wear performance of engine tribological systems. The industrial importance of this work cannot be underestimated since friction at lubricated interfaces in engines is what governs the fuel consumption in vehicles. Reducing fuel consumption is the single most important driver in this industry both in terms of sparing use of hydrocarbon reserves and reducing harmful emissions."" **Prof Ardian Morina, University of Leeds**

For further information

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