AN INVESTIGATION INTO THE EFFECT OF LAMBDA RATIO ON ZDDP TOPOGRAPHY AS ANALYSED IN AN ATOMIC FORCE MICROSCOPE

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topography; atomic force microscopy; ZDDP

INTRODUCTION

The use of Atomic Force Microscopy (AFM) for nanomechanical mapping has been increasingly popular in tribology over the last two decades [1][2]. It is well established as a method of qualitatively measuring the topography of a surface and is increasingly used to semi-quantitatively determine the thickness of tribofilms[3][4].

This research will determine the full extent to which atomic force microscopy can be used to characterize tribofilms formed, from oil containing primary ZDDP, under differing operating conditions. . This research will focus on the topography and thickness of tribofilms produced using an MTM and a TE77.

METHODOLOGY

A Dimension Icon Scan Asyst AFM was utilized to analyse tribofilms formed with an MTM and a TE77. The conditions used were speeds within the range of 200mm/s to 500mm/s, contact pressures of 1.105GPa to 1.216GPa and temperatures within the range of 80°C to 120°C.

The topography of each sample was measured using a scan size of 30µm x 30µm and a scan rate of 0.528Hz. The thickness was determined by partially cleaning the samples with discrete droplets of 0.5M EDTA and then taking an 89µm x 89µm scan. The friction coefficient was determined and the wear was measured using the talysurf, once all tribofilm analyses had been completed.

RESULTS

Figure 1 shows some of the current results.

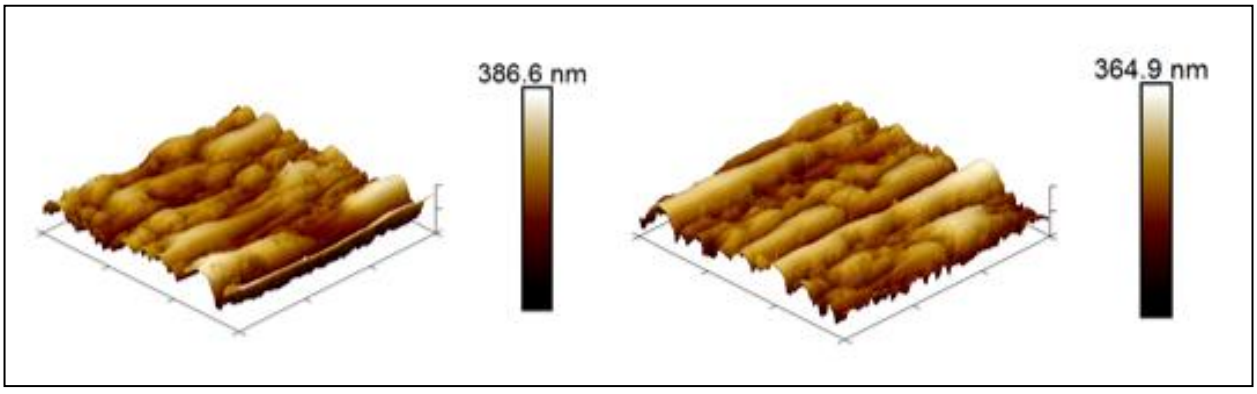

Figure 1. 30µm x 30µm AFM topography images of a ZDDP Tribofilm

DISCUSSION

This work shows the significance of initial lambda ratio on tribofilm topography. This enables a better understanding into the decomposition of ZDDP, such as the effect of sliding direction on phosphate pad elongation. Having investigated the different topographies ZDDP can form under given conditions it is now possible to better compare ZDDP tribofilms that have been formed using traditional tribometers, with those formed within an AFM.

FUTURE WORK

In the next stage of this research ZDDP tribofilms will be generated in the AFM, such that the topographies can be compared between the different generation methods. If the topographies are comparable, although on a considerably different scale, future work will consider the efficacy of analyzing tribofilm topography in-situ. This will be investigated by conducting a topical investigation utilizing both techniques, such as the effect of water contamination.

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