Tribochemistry of the lubricant additives/WDLC system under Boundary Lubrication

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1. Introduction

Diamond-Like Carbon (DLC) coatings are considered to be very promising choice for coating automotive engine components in recent years. This is mainly due to their superior mechanical properties. Application of these coatings for engine components is seen as an alternative approach towards reducing the current dependence on some high SAPS additives. However, their lubrication mechanism is still not fully understood, mainly due to the wide range of DLC coatings available and their chemically inert nature. Understanding the interactions of coating/additive tribological systems and the structure change of the carbon coating after the tribometer tests is essential in order to optimize such systems.

2. Method

In this study, the structure change of the carbon coating in terms of graphitization will be investigated and compared by Raman spectroscopy, X-ray photoelectron spectroscopy (XPS) and transmission electron microscopy (TEM) – electron energy loss spectroscopy (EELS). The selected samples are from the pin-on-plate reciprocating tests with additives (ZDDP, GMO and MoDTC) across a range of temperature from room temperature to 150˚C. The effect of additives in the graphitization process will be further discussed and linked with the friction and wear performance shown by the tribometer test results.

3. Results

Example of a three Gaussian's fitting for the Carbon K-edge EELS spectrum is shown in Figure 1. The sp^2 content is quantified with a reference to highly ordered pyrolytic graphite (HOPG). Raman results are compared with the EELS results in terms of carbon graphitization. XPS surface analysis is carried out in terms of understanding the surface interactions of the additives.

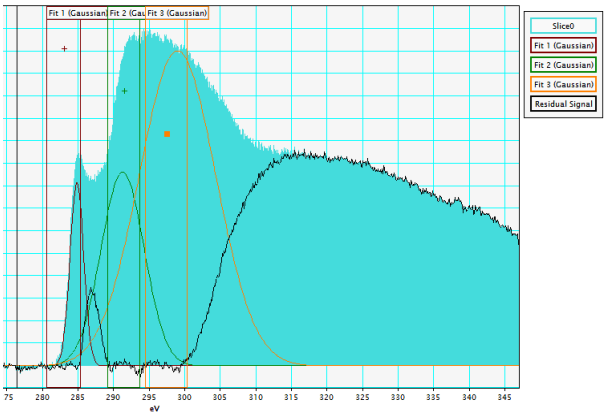

Figure 1 Example of EELS spectrum by a three Gaussian's fitting. *(W-DLC/CI surface, MoDTC+ZDDP, 2hrs, 100˚C)*

4. References

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