Comparing the benefits of a rapidly-formed tribofilm against less tribological active DLCs over time

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1. Introduction

Diamond-like Carbon (DLC) coatings are increasingly used to reduce wear rates and lower friction. Both metal and non-metal doped DLCs are being utilised with the motivation of enhancing DLCs friction and wear profile.

Silicon is often incorporated into DLC as it is known to affect the films sp3/sp2[1] ratio,this in turn can affect the film's hardness. Silicon's incorporation can also affect chemical reactivity of the film[2].

It is still not well-understood how DLC interacts with conventional lubricant additives. Dopants may increase DLCs affinity for lubricant additives by increasing the film's reactivity.

Investigation is undertaken into whether a Sidoped DLC, will undergo less wear than an un-doped DLC over long duration sliding due to enhanced tribofilm protection.

Mechanisms of wear protection are exploredusing SIMS and TEM/EDX specta.

2. Method

Both DLCs were tested with a fully formulated engine lubricant that includes well-known anti wear elements (Zn,S,P). Friction and wear experiments were carried out using a TE77 reciprocating tribometer. Several measurements at different timeintervals were taken (2h, 7h).

Wear is examined using white-light interferometry. Tribofilm formation is evaluated using TEM/EDX.

3. Preliminary Results

Silicon doped DLC does appear to form a thick tribofilm with many elements identified as important to wear reduction:S,Zn,P[3]. The corresponding tribofilm formed on undoped DLC is notably less thick.

Relative wear rates are compared. Si-DLC's relative wear appears to decrease more steeplywith time than undoped a-C:H.This may be due to the formation of a thicker tribofilm with more anti wear elements incorporated within the film.

4. Summary:

Despite having comparable coefficients of friction in the same oil (μa-C:H = 0.09, μSi-DLC = 0.089) Si-DLC hashigher total wear.

However, the relative wear rates of Si-DLC does seem to decrease with time far more sharply than that of a-C:H DLC.

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