WEAR MECHANISM AND MICROSTRUCTURES OF THE SPUTTERED CARBON/CHROMIUM HARD COATINGS

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ABSTRACT

Sputtered carbon hard coatings have been recognised as solid lubricant films with the potential to be used for many wear resistant applications. The wear mechanism of the sputtered carbon coatings is, however, not well understood. The coatings were deposited to polished M42 tool steel and tungsten substrate. Pin-on-disc wear test was used to study the friction and wear characteristic of the coating and also to provide rubbed surface for analysis. The coating withstood pin-on-disc test with sliding speed 200 mm/s against 5 mm diameter WC ball under load 140 N which produced a counter-pressure higher than 3.4 GPa. The specific wear rate of the coating was measured as low as around 10^{-17} m^3/Nm little dependent on the load, whilst the friction coefficient was around 0.06 (fig 1).

The rubbed and unrubbed surfaces were studied using XRD, SEM, and HRTEM. The coating was found to be mainly amorphous with some nano-crystallised graphite like clusters (fig 2). The rubbing was shown to cause a re-orientation (fig 3) of the clusters and it is thought that the excellent tribological performance is associated with the re-orientation at the surface.

Fig 1  Friction forces as function of load during test

Fig 2  Cross section HRTEM of the coating

Fig 3  Reorientation of the carbon clusters due to rubbing