EXPERIMENTAL OBSERVATION ON THE DEFORMATION OF DIMPLED SURFACE IN SOFT-EHL CONFORMAL CONTACTS

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ABSTRACT
Surface texture has proven to be an effective method to improve tribological properties of lubricated sliding surfaces. The contacting situation becomes much more complicate when it comes to soft tribo-contacts, such as joint prosthesis and elastic sealing ring. Under these circumstances, the elastic deformation of textured surface has been found to influence the tribological properties significantly [1-3].

In order to study the effect of deformation of textured soft surface on the lubrication performance, a simple and low-cost chemical deposit approach was applied to form a thin reflective layer of silver on the surface of polydimethylsiloxane (PDMS) substrate to satisfy the experimental requirements of optical interferometry. A BK7 glass disk was driven to rotate against the substrate of PDMS. The observation on the deformed surface around the dimple in soft-EHL conformal contacts was realized and conducted systematically under a simple sliding condition with constant loads by using optical interferometry (Fig. 1).

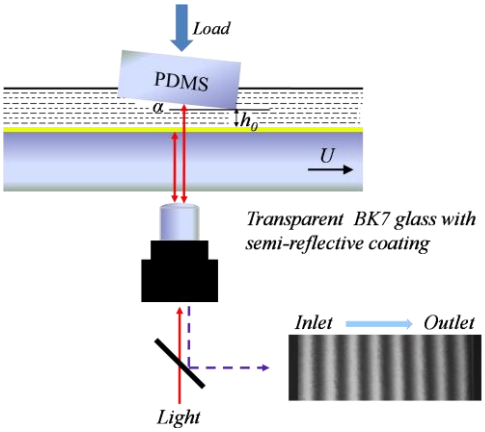

Fig.1 Schematic diagram of the slider-on-disc setup using optical interferometry

The results show that uneven deformation emerges around the dimple in soft-EHL conformal contact. Both the applied load and sliding velocity have significant influence on the deformation of the soft surface, even the deformation pattern. The representative interferograms around dimples in soft-EHL conformal contacts under different loads are shown in Fig. 2. It is generally recognized that the soft surface will be depressed due to the effect of hydrodynamic pressure, but observational results show that maximum deformation of the soft surface not occurred at the position where maximum hydrodynamic pressure generated. Some region in convergent wedge even raises in some cases, just as shown in the dotted box in Fig. 2 when load=6.86. This may be attributed to the shear strains of the soft surface, which make the leading edge of the dimple much easier to collapse, it is of course required further numerical simulation to verify.

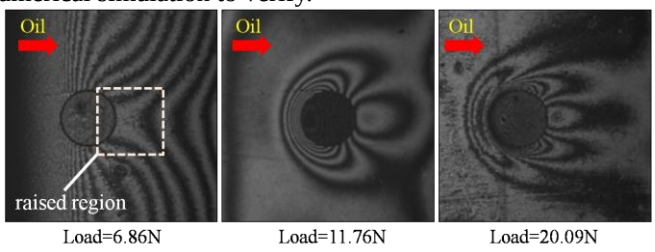

Fig.2 Representative interferograms around dimple in soft-EHL conformal contacts under different loads

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REFERENCES
[1] Yagi K, Sugimura J. Elastohydrodynamic simulation of Rayleigh step bearings in thin film hydrodynamic lubrication. Tribology International. 2013;64:204-14.

[2] Shinkarenko A, Kligerman Y, Etsion I. The Effect of Elastomer Surface Texturing in Soft Elasto-Hydrodynamic Lubrication. Tribology Letters.

[3] Su B, Huang L, Huang W, Wang X. The load carrying capacity of textured sliding bearings with elastic deformation. Tribology International. 2017;109:86-96.