EVOLUTION OF SURFACE ROUGHNESS IN SOME TRIBOLOGICAL CONTACTS

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KEYWORDS

Surface roughness; Friction; Contact mechanics; Surface finish

ABSTRACT

Surface roughness evolution in tribological contact depends on the material properties, wear mechanism, and contact conditions. The dynamics of the process can be influenced by contact mechanics, plastic deformation, fracture, adhesion, and many other processes. However, many materials display a naturally emerging, self-affine level of roughness. While many experiments have shown the effects of roughness evolution, much less is known about the origin of roughness emergence and the mechanisms governing its dynamics.

In this study, both the influence of initial roughness on the dynamic evolution of interface morphology and the governing mechanism have been analysed experimentally. A few different, mainly metallic materials (titanium alloy, steel alloy, aluminium, and brake pad composite) have been analysed under severe fretting contact conditions. Friction and wear have been tested in the classical sphere/plane configuration using a linear reciprocating tribometer with a very small displacement of 130 to 200 microns. After an initial period of rapid degradation, the dynamic evolution of surface roughness converges to a certain level specific for a given tribosystem (Figure 1). However, roughness at such a dynamic interface is still increasing, and analysis of the initial roughness influence revealed that, to a certain extent, a rheology effect of the interface can be observed. Therefore, the dynamic evolution of roughness will depend on the initial condition and history of interface roughness evolution. Multiscale analysis shows that the morphology created in the wear process is composed of nano, micro, and macroscale roughness.

The analysis of Power Spectral Density of worn surfaces also supports this hypothesis that the abrasive wear process takes place at many different scale levels. Self-similarity and the fractal character of the surface roughness created in tribological contact confirm the self-affine level of roughness. The role of material properties like grain size, microstructure, and mechanical properties is analysed in detail to reveal factors influencing the underlaying mechanism of surface roughness evolution.

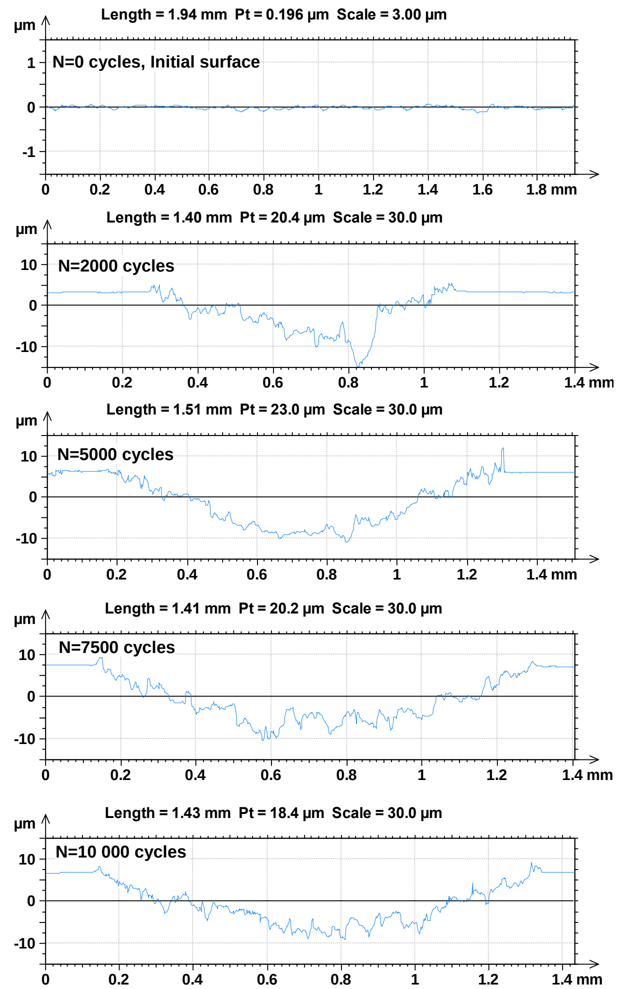

Figure 1: Dynamic evolution of roughness profiles during wear process, 2D profile taken in a middle cross section in direction perpendicular to contact sliding direction (plane material Ti-6Al-4V, P=20 N, δ^*=130 µm, F=15 Hz) [1].

REFERENCES

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