THE UPPSALA LOAD-SCANNER - AN UPDATE

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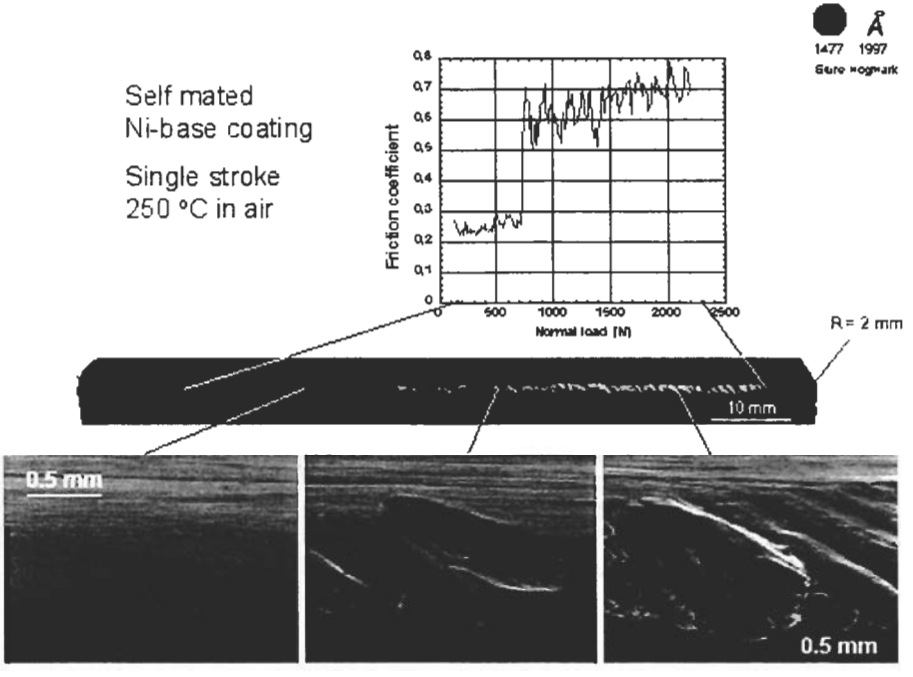
Abstract

This paper promotes a new test for assessing the friction and wear properties of materials and lubricants. Two elongated test specimens, preferably bars or rods, are used. The orientation of the test specimens and their relative sliding during testing distinguish it from all traditional tribological tests. It is arranged in such a way that the contact moves along a sliding path on each specimen. Each spot along this path on one specimen will only make contact to one spot in the path of the other specimen, and vice verse. Consequently, each contact spot will display a unique tribological history after test completion, which facilitates the determination of critical loads to galling, surface cracking, coating detachment, etc. The Load Scanning test is evaluated by plotting the friction history and imaging the worn surface by optical microscopy (OM) or scanning electron microscopy (SEM). It can preferable be used to study and classify materials, coatings and lubricants as to friction and wear properties in sliding contact. Especially, the generation of wear maps are facilitated as compared to using conventional tribological testing.

The detailed test configuration has been reported earlier [1, 2]. Examples of the applicability of the Uppsala Load Scanner are given below.

Examples of test result from the Uppsala Load Scanners

In a single stroke test, any sudden change in friction can be directly linked to the corresponding damage in the sliding path since there is a one-to-one correlation between the position along the sliding path and the normal load. Thus, microscopical studies of the sliding path are easily correlated to the frictional behaviour, cp. Fig 1.



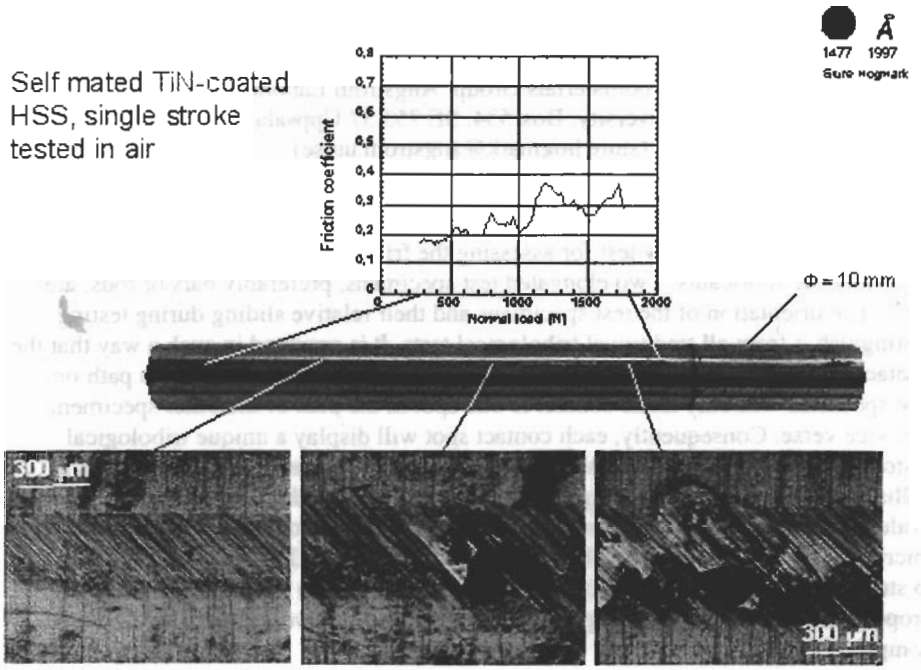

Self mated TiN-coated
HSS, single stroke
tested in air
1477 1997
Sture Hogmark
Friction coefficient
Normal load (N)
Φ = 10 mm
300 µm
300 µm

Fig. 1 b)

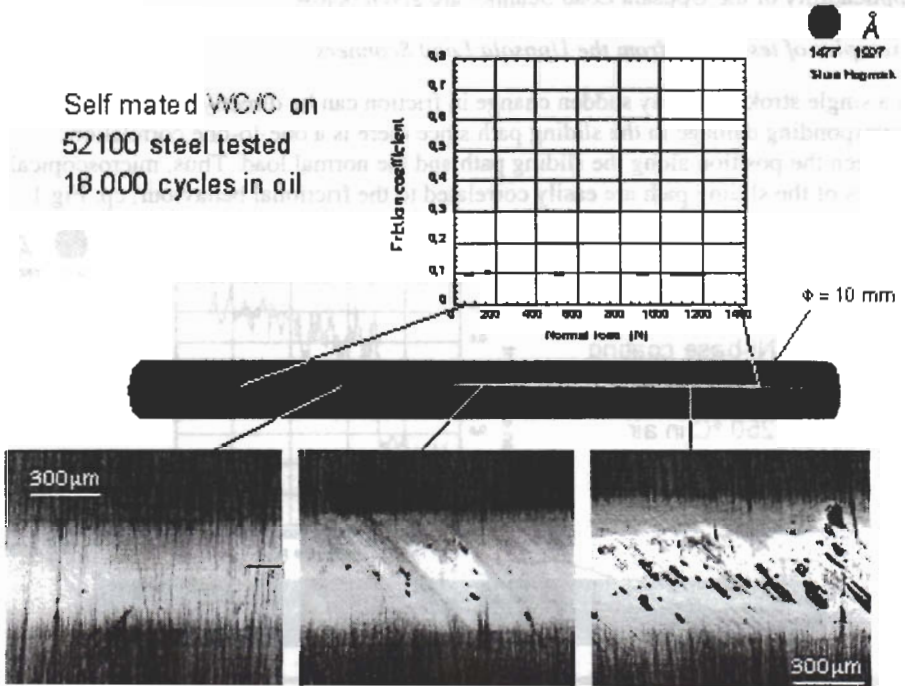

Self mated WC/C on
52100 steel tested
18.000 cycles in oil
1477 1997
Sture Hogmark
Friction coefficient
Normal load (N)
Φ = 10 mm
300µm
300µm

Fig. 1 Representative results from the Uppsala Load Scanner. One of the two mating test rods is shown together with the corresponding friction recording. A selection of three OM photos are also given for each test, and their approximate position along the test rod is indicated by bars. Note that the width of the sliding path increases with the normal load.

a) Friction recording, and typical appearance of the wear track of a Ni-based material. Galling is initiated at a normal force of about 800 N. Note that galling involves severe metal transfer between the test rods. When there is a big chunk of material attached to the wear track of one of the test rods, there is a corresponding large groove at the same position in the wear track of the other.

b) Friction and wear characteristics of self mated, physically vapour deposited (PVD) TiN on high speed steel. Cylindrical test rods (Ø = 10 mm) were used. The sliding speed was 0.01 m/s and the single stroke test was performed in dry ambient atmosphere. Coating detachment occurred when the load exceeded 800 N, corresponding to 2.5 GPa, as estimated from the width of the sliding path. Thereafter, the friction raised and became more irregular.

c) Friction and wear characteristics of DLC-coated ball bearing steel (AISI 52100) tested in reciprocal sliding. The coating has worn gradually, and the substrate is appearing at a load of about 600 N. The OM picture taken at a position along the sliding path where the load was about 1000N shows evidence of scuffing in the revealed substrate material.