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POSSIBILITY OF ELASTO-HYDROSTATIC EVOLVED-GAS BEARING AS ONE OF THE MECHANISMS OF SUPERLUBRICITY

T. Kato and M. Nosaka

katox@mech.t.u-tokyo.ac.jp

Surface Science and Tribology Lab
Department of Mechanical Engineering, School of Engineering
The University of Tokyo
7-3-1 Hongo Bunkyo-Ku, Tokyo 113-8656, Japan

ABSTRACT

We have reported [1-3] that the friction coefficient reduced to the friction-tester noise-level of 0.0001 when ZrO_2 pin was slid against diamond-like carbon (DLC) plate under H_2 gas or H_2 and N_2 gas mixture environment, and we termed this behavior as friction fade-out (FFO). It was also reported that the tribofilm formation on ZrO_2 surface during run-in process played a very important role for the onset of FFO, and that the onset of FFO depended on an existence of alcohol vapour, humidity conditions of supply gas and applied load conditions. For the mechanism of FFO, we investigated the tribofilms on ZrO_2 and the worn surfaces of DLC by several kinds of chemical analyses such as FTIR, TOF-SIMS, Raman Spectroscopy and XPS, and by surface analyses such as nano-profiler, nano-indentation tests and SEM observations. It was found that the tribofilm involved short-chain hydrocarbons and hydrogen atoms coming from dehydrated alcohol molecules, in addition to the aromatic series ($C_6H_5^+$ and $C_7H_7^+$), condensed-ring ($C_9H_7^+$) and benzoic acid ($C_7H_5O^-$) which were also detected from the wear tracks of DLC surface, and that soft and semi-insulating polymer-like materials were attached on the tribofilms and grew with sliding. Based on these measurements, the possibility of elasto-hydrostatic gas bearing as the mechanism of FFO is investigated, where gas is not supplied from outside of pocket but evolved at the contact surface. Assuming the generation of hydrocarbon gases by ZrO_2 catalytic action and dissociative H atoms, the pressure distribution at the contact area and the evolved gas amount required for supporting a heavy applied load of 60 N will be shown.

REFERENCES

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