IN SITU OBSEVATION OF FRICTION INDUCED STRUCTURAL CHANGE IN HYDROGEN ATMOSPHERE

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ABSTRACT
The fundamental processes occurring with diamond-like carbon (DLC) sliding in hydrogen were studied. It is known that the sliding of DLC shows low coefficient of friction below 0.1 in hydrogen [1]. However, there is little precedent observed the structure of DLC during sliding in hydrogen.

Recently, we have developed an in situ system to observe the behavior of lubricant during friction by combining Raman spectrometer with the friction equipment in hydrogen as shown in Figure 1. Also, we have analyzed the tribofilm formed with the sliding by using the synchrotron XPS@KEK-PF-BL13B.

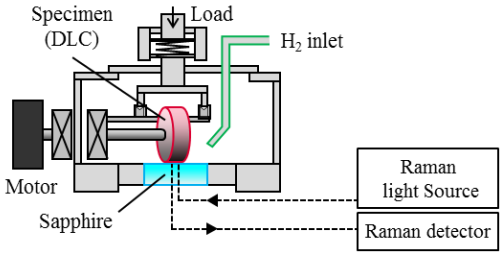

Fig.1 Schematic diagram of Raman in situ observation system

In this study, we will report the experimental data of structural change of DLC in hydrogen as measured using the in situ observation, and the synchrotron XPS.

Figure 2 shows Raman spectra obtained after test. We have assigned the bands of DLC with some papers. The spectra after test show the large change at ca. 1605 cm^{-1} corresponding to G-band and ca. 1350 cm^{-1} corresponding to D-band. The peak position of G-band and the coefficient of friction obtained by using in situ observation system are shown in Figure 3. The peak position was shifting with changing coefficient of friction lower.

The each component in C1s XPS spectra of DLC was obtained by the synchrotron XPS. The area of dangling bonds in the tribofilm was smaller than in the initial DLC, but the area of sp2 C-C band was larger.

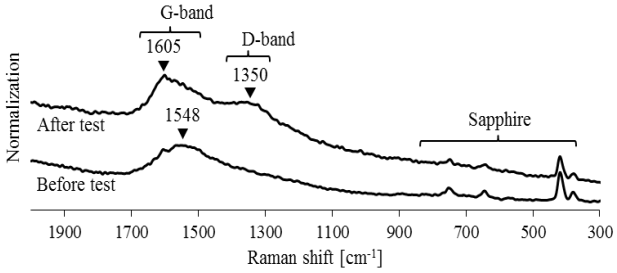

Fig.2 Raman spectra after test

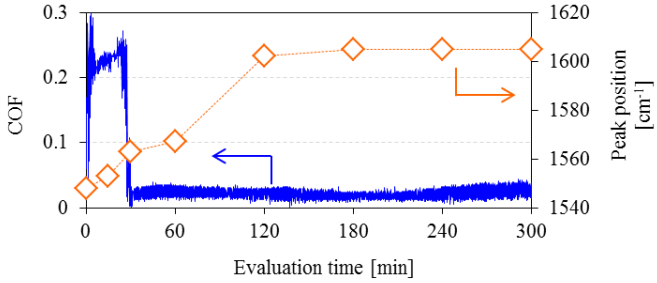

Fig.3 Time dependence of the peak position and COF

Based on these experimental results, it is suggested that the dangling bonds of DLC are changed to the sp2 (C-C) band structure with sliding in hydrogen, which induces low friction.

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