

## MULTIMODAL MEASUREMENT OF POLYMER BRUSH SUPERLUBRIC INTERFACE

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### KEYWORDS

Coatings; Experiments in tribology; Wear, Polymer brushes

### ABSTRACT

Recently, concentrated polymer brushes (CPBs) have attracted attention as superlow frictional tribomaterials exhibiting a friction coefficient 0.001 [1]. The lubrication and wear mechanisms of CPBs have been investigated to achieve durable, superlow frictional tribosystems. Several previous studies inferred that CPBs have a multi-layered structure with different densities and mechanical properties, and such a layered structure plays an important role in friction and wear [2]. However, the layered structure has not been classified clearly, and the relationship between the structure, lubrication, and wear of CPBs has not been discussed sufficiently.

In this study, we developed a homemade apparatus conducting time-resolved simultaneous measurements of the interfacial gap and mechanical response of polymer brush superlubric interface. A point contact was formed between a steel ball and a CPB-coated glass disk immersed in the good solvent of CPB. The ball was mounted on a 3-axis force sensor. The disk was mounted on a piezostage controlling the 3-axis positions and was subjected to oscillation in the Z-axis direction. The indentation test was conducted to monitor the following quantities: three-directional forces ( $F_x$ ,  $F_y$ ,  $F_z$ ), the phase shift between the input and output oscillations ( $\varphi$ ), and the interfacial gap between the steel ball and glass plate ( $h_{\text{gap}}$ ). The “force-gap curve” and “phase-gap curve” were obtained from the indentation test, as shown in Figure 2. Analyzing these curves classified the CPB into three layers from the bottom: the concentrated layer, the middle layer, and the dilute layer. First, the concentrated layer thickness was determined by the film thickness at the phase shift of 0 deg ( $h_{p2}$ ). Then, the dilute layer thickness was determined by the difference between the thicknesses when the phase shift began to decrease from 90 deg ( $h_{p1}$ ) and when the normal force began to increase ( $h_{f1}$ ). Finally, the middle layer thickness was determined to be halfway between the concentrated and dilute layers.

Further details not listed in the original paper [3] will be presented in the presentation.

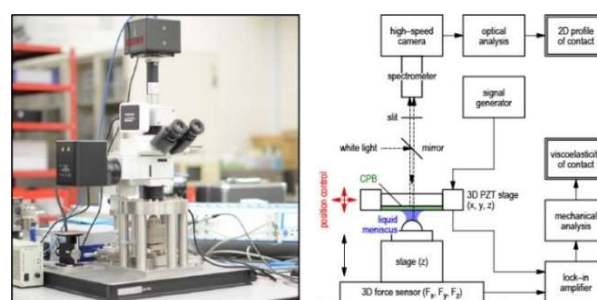


Fig.1 Appearance (left) and schematic of the apparatus (right).

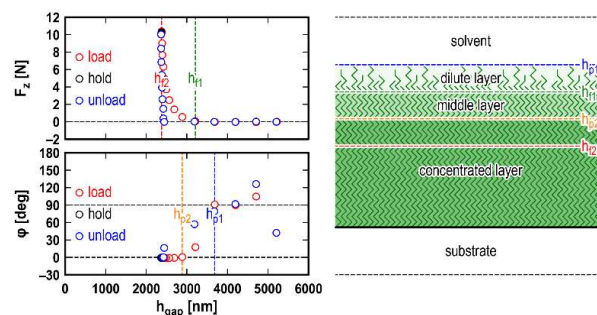


Fig.2 Results of the indentation test (left) and layered structure of CPB (right).

### ACKNOWLEDGMENTS

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### REFERENCES

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