

## ROLE OF PROBE VERTICAL LIFT IN POLYMER BRUSH FRICTION AND WEAR

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### KEYWORDS

Coatings; Experiments in tribology; Wear, polymer coating

### ABSTRACT

Concentrated polymer brushes (CPBs) synthesized by advanced surface-initiated controlled radical polymerisation have received increasing attention in the tribological field because CPBs in good solvents exhibit superlow friction phenomena under macroscopic severe sliding conditions. To realize tribological element applications of CPBs, an understanding of the lubrication mechanisms of CPBs is required to develop a method to enhance their durability.

In this study, an operand tribo-Raman spectroscopic method, which is an effective tool for revealing the friction and wear mechanisms of tribo-materials (see Fig.1) [1], was mainly conducted on the frictional interface between a polymethyl methacrylate (PMMA)-CPB and a bearing steel ball immersed in an ionic liquid (IL), which is a good solvent for PMMA-CPBs.

From the operand tribo-Raman results, the concentration and molecular structure of the PMMA-CPBs and IL at the frictional interfaces were found to be constantly changing with the sliding cycles during operation as can be seen in Fig.2. As can be seen in Fig.2 (left), the probe vertical lift which is characterized by an increment in a lubrication film thickness  $h_{IL}$  was observed in the initial period of the sliding test. In our previous studies, we have reported that the PMMA-CPB has a layer structure that is classified as three layers: “dilute layer (schematically shown as “layer 2” in Fig.1)”, “middle layer”, and “concentrated layer (schematically shown as “layer 1” in Fig.1)” based on the molecular distribution of the brushes [2]. It should be noted that the degree of the vertical lift is almost equal to the dilute layer film thickness (approximately 500 nm) of the PMMA-CPB. On the other hand, the vertical lift film thickness gradually decreased during the sliding test, and the vertical lift phenomenon ended during a certain period. After the vertical lift period, it is interestingly noted that high friction transition (not shown in here) and wear acceleration phenomena (Fig.2 (right)) were simultaneously observed. Consequently, our results suggest that the dilute layer-derived vertical lift of CPBs at frictional interfaces plays a role in the friction and wear of CPBs.

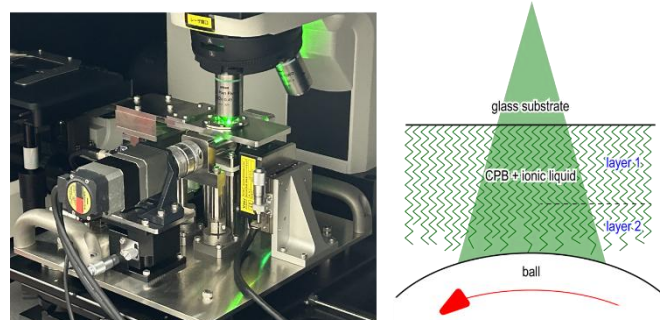


Fig.1 Appearance of the apparatus (left) and the schematic of the frictional interface of the PMMA-CPBs (right)

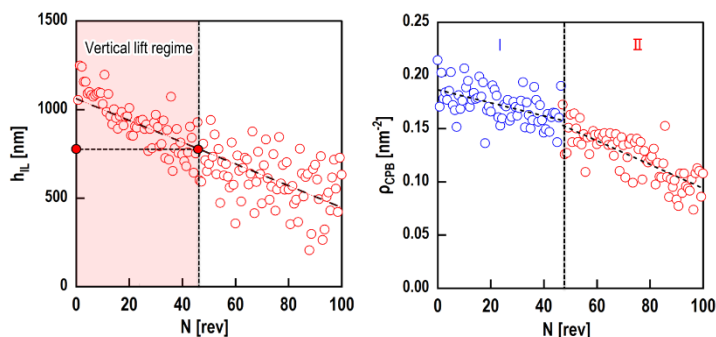


Fig.2 Time-dependent IL film thickness (left) and the graft density of the CPB behaviors (right) obtained from the time-resolved Raman spectra.

### ACKNOWLEDGMENTS

This study was supported by CREST (JPMJCR2193) and ACT-X (JPMJAX23D4).

### REFERENCES

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