PREPARATION AND TRIBOLOGICAL BEHAVIOR OF PAH/PAA MOLECULAR DEPOSITION FILMS

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ABSTRACT

PAH/PAA polymer multilayer ultrathin film was prepared by molecular deposition technology. The morphology and nano-tribological behaviors of the film were investigated by using atomic force microscope (AFM). It has been found that the friction force of the PAH/PAA polymer molecular deposition film is obviously less than that of the glass substrate, and the friction force increased with increasing load. However, the friction force decreased in the beginning and increased in the sequel with increase in the number of layers, which might be attributed to the change of surface topography with different layers. Moreover, it was found that the profile of both topography and lateral force has good coherence by analyzing the AFM images.

1. INTRODUCTION

Molecular deposition (MD) that uses the electrostatic force to assemble compounds to form multilayer film is a new type method of preparation of multilayer film in recent years [1,2]. As the early research results, MD film can repair the friction surface and decrease the friction force with the reason that it can decrease the adhesive force on the surface [3]. In this paper, a multilayer polymer MD film of PAH/PAA on glass substrate was prepared, and its tribological behavior was investigated using AFM.

2. EXPERIMENTAL DETAILS

A hydroxylated glass wafer is first immersed into $10^{-4}$ mol/dm$^3$ PAH solution for 30 minutes, after that, the substrate is washed by deionised water. Secondly, the substrate pre-coated PAH is immersed into $10^{-4}$ mol/dm$^3$ PAA solution for 30 minutes followed by washing with deionised water. Finally, the film containing different numbers of layer is prepared by repeating the above steps.

The tribological behavior of the films is investigated by using a Topometrix explorer 2000 atomic force microscope (AFM) with standard silicon nitride tips in contact mode.

3. RESULTS & DISCUSSION

As shown in Figure 1, the AFM images confirm that a multilayer polymer MD film of PAH/PAA on glass substrate was prepared. Figure 2 gives the variation of the friction force of the same with normal force. As a result, the friction force of the MD films is lower than that of the bare glass. For the odd layers with the same outer layer (PAA), the film with 5 layers has the lowest values of friction force.

The friction force decreased in the beginning and increased in the sequel with increase of the number of layers, which might be attributed to the change of surface topography with different layers as shown in Table 1. From Figure 3, it was found that the profile of both topography and lateral force had good coherence by analyzing the AFM images.
Figure 1. AFM topography images of PAH/PAA MD films (1000nm×1000nm)

Figure 2. Variation of the friction force of the films of different layers with the normal force

Figure 3. Profile of both topography and lateral force by AFM images

CONCLUSIONS
The molecular deposition film of PAH/PAA film on the glass substrate is able to obviously decrease the friction force, and the friction force increased with increasing load. The friction force decreased in the beginning and increased in the sequel with increase of the number of layers, which might be attributed to the change of surface topography with different layers. It was found that the profile of both topography and lateral force had good coherence by analyzing the AFM images.

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REFERENCES

Table 1. The friction force and surface roughness of MD films at normal force 3.17 nN

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<th>Number of layers</th>
<th>Roughness(nm)</th>
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<td>0</td>
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