ENHANCED TRIBOLOGICAL PROPERTIES OF GRAPHENE-BASED NANOCOMPOSITES

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Keywords: Graphene, Tribological properties, Nanocomposites

ABSTRACT

Graphene materials have exhibited extraordinary tribological behavior due to its unique 2D layered microstructure, implying great potential of the graphene as emerging lubricants used in many fields. The aim of this work is to explore commercial application of multi-layer graphene as reinforcing fillers in the field of composite materials.

1 INTRODUCTION

Graphene, a two-dimensional lamellar structured material, easily shears at the contact surfaces and exhibits excellent mechanical strength and conductivity, which promises its potential for tribological applications. We obtain graphene/PVC composites with high tribological performance by taking full advantages of high self-lubricant properties of graphene. In addition, we also explor the tribological properties of graphene enhanced lubricating oil. In this work, our purpose is to explore commercial application of multi-layer graphene as reinforcing fillers in the field of composite materials.

2 EXPERIMENTALS

We used commercial graphene and PVC as raw materials. The base oil was provided by Jiangshu Huifeng lubricatant Co, Ltd. All the nanocomposites were fabricated using conventional melt-mixing and hot-press methods. We use a universal friction tester for meansuring fiction coefficient and wear scar dameter.

3 RESULTS AND DISCUSSION

First of all, we investigated the enhanced tribological performance of graphene/PVC composites. Figure 1 shows that the graphene/PVC composites exhibit much lower friction coefficient and lower wearing rate than the neat PVC, indicating that the presence of graphene could greatly increase tribological performance of the nanocomposites[1]. Such enhanced tribological properties are mainly attributed to enhanced toughness and excellent self-lubricating properties of the graphene-based materials.

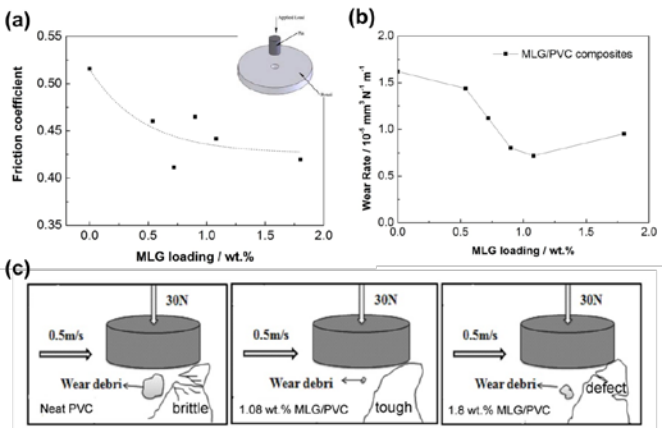

Fig. 1 Tribological performance and reinforcing mechanism of graphene/PVC composites

On the other hand, we prepared graphene-filled lubricating oil and investigated its lubricating properties. For graphene-based lubricating oils, there still exist some unsolved problems, for examples, the tribological properties strongly depend on type, size, morphology of graphene; the compatibility between oil and graphene directly affects the graphene dispersion and stability of the oils; the friction coefficient and tribological properties of the graphene-based oil should be further improved. In this work, we carried out some research on graphene dispersion, size distribution, morphology adjustment, and tribological properties. We found that the treated graphene showed satisfactory dispersion and good stability in base oil, and no obvious change could be observed after a long periods. Moreover, we can see clear that the presence of graphene can decrease the friction coefficient, and the wear scar diameter (WSD) decreases from 722 μm to 433 μm, indicating that the graphene can greatly improve tribological properties of lubricating oil. The increase in tribological performance for the graphene-based lubricating oils is mainly attributed to the extraordinary self-lubricating characteristic and intrinsic low friction coefficient of graphene. Moreover, the some influencing factors of narrow size distribution and good compatibility and stability also play important role in increasing tribological performance. Therefore, we can see that there is great potential for graphene to be used as high-performance lubricants in many industrial fields.

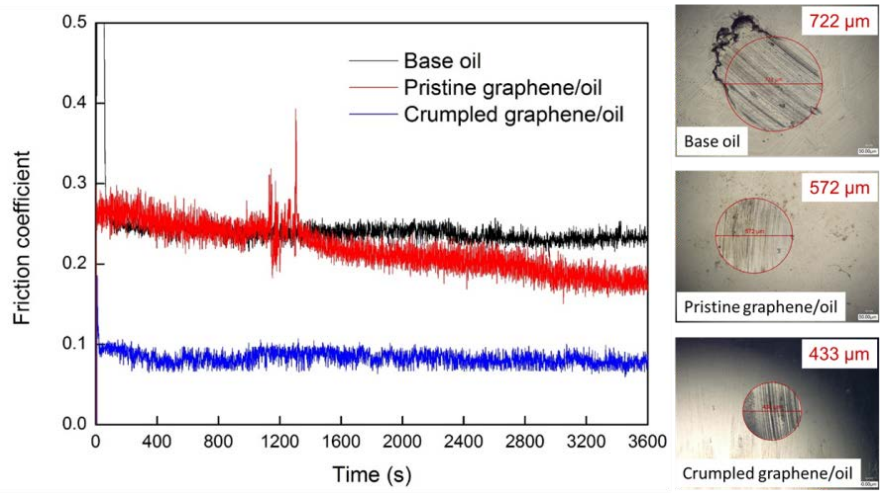

Figure 2. Friction coefficients and wearing scar of the graphene-based lubricating oils

4 CONCLUSION

In this work, we studied the tribologycal peroperties of graphene as nano-fillers in polymer composites and lubricant oil. We found that the presence of MLG could increase the tribologycal performance of the MLG/PVC composites and the graphene-based lubricating oils due to high flexibility of the crumpled MLG. In light of its high tribological performance, graphene composites have great potential to be applied in many fields.

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