High-tech anti-wear lubricant based on carbon nanotube/ionic liquid combination

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1. Introduction

Nowadays the development of lubricant is relevant because of the ongoing needs for reducing energy and material losses in mechanical devices. The aim of the present study is to investigate the applicability of carbon nanotube/ionic liquid composites as novel protective lubricating films for metal wear parts. Either nanoparticles or ionic liquids independently have been shown to exhibit exceptional lubricating qualities[1,2]. However, the combinations of the two have not been demonstrated before.

2. Ionic liquids

Ionic liquids have remarkable lubrication and anti-wear capabilities as compared with lubrication oils in general use. Ionic liquids are suitable at harsh friction conditions that require high thermal stability and chemical inertness[3]. There is a very wide range of different ionic liquids and their properties can be modified by selection of suitable cation and anion.

In current study different imidazolium and bis-imidazolium ionic liquids with TFSI (bis(trifluoro-methane)sulfonimide) and FAP (trifluorotris(pentafluoro ethyl)phosphate) anions were investigated. To obtain better adhesion with lubricated surface polar functional groups were added to ionic liquid cation structure.

3. Nanoparticles

In recent years nanoparticles have gained much attention as the extreme pressure and anti-wear additives to lubricating oils [4]. Reasons behind this include remarkable tribological behavior of nanoparticles even at severe frictional conditions (high temperature, high load and high sliding speed), and their self-repair function to the worn surface, and good environmental-friendliness [5]. Adding only a small amount of nanoparticles to a lubricant can significantly improve its lubricating properties.

4. Summary

Ionic liquids were combined with differently functionalized carbon nanotubes and obtained mixtures were tested with standard tribological tests. The combination of carbon nanotube/ionic liquid can significantly reduce the long-term instability and clustering of the particles in suspensions (e.g. oil suspensions), as it is well known that ionic liquids are highly effective stabilizer for nanoparticles[6]. In addition, the novel type lubricant has many advantages and can also widen the range of applications, e.g. wider temperature range and preserved functionality at harsh conditions where oil-based lubricants fail.

5. References

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