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Tribological characteristics of graphene as grease additive under different contact forms

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Abstract: The tribological properties of graphene as grease additive were investigated under different contact forms and the worn surfaces were examined by X-ray photoelectron spectroscope (XPS) and Raman Spectrometer to reveal tribological mechanism. By the addition of graphene, the antiwear ability and friction reduction performance of grease were significantly improved. It is concluded that graphene can not only act as a deposition film to protect the substrate, but also stimulate formation of Fe_2O_3 and Li_2O tribofilm. And the synergism of deposition film and tribo-chemical film significantly improve tribological properties of grease. In addition, the easy shear capability of graphene is prone to interlayer slip under the action of friction, thus decreasing the friction coefficient and promoting friction reduction performance of grease.

Key words: graphene; additive; tribology; contact form

1. Introduction

Friction and wear is a major reason for the failure of mechanical equipment and the increase of energy consumption, while lubrication primarily contributes to reducing the wear of mechanical equipment and prolonging its service life. The lubricant can form lubricant film on the surface of friction pairs, preventing its direct contact, thereby significantly reducing friction coefficient and wear loss [1]. However, with the development of mechanical equipment, lubricants cannot meet the requirements of severe environment, such as heavy load, high temperature and high speed. Additives need to be added to lubricant to further enhance the anti-wear ability and friction reduction property and extreme pressure performance of lubricant, thereby improving the tribological properties of mechanical equipment [2,3].

As a lubricating additive, graphene has attracted extensive attention for its application in the tribology field due to its ultra-thin layer structure, excellent mechanical properties and self-lubricity [4-6]. Numerous studies suggest that a small amount of graphene as lubricating additive not only can be used as a nano-bearing to