

Ionic Liquids-Graphene Composite Carbon-based Lubricating Films

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Ionic liquids (ILs) have drawn significant attention in field of lubrication due to their unique physical and chemical properties including negligible volatility, nonflammability, high chemical and thermal stability, efficient heat transfer properties, ionic conductivity, and wonderful molecular tailoring property. Many groups have reported excellent lubrication performance of ILs as lubrication oils, additives and thin films in various environments including harsh space condition. However, the insufficient antiwear performance of pure ILs films has restricted their lubrication-related applications, such as micro/nanoelectromechanical systems (MEMS/NEMS) and space application. To further enhance the bearing capacity and lifetime of ILs films, IL-based composite lubrication films with both reducing friction and load-carrying phases have received considerable interest. For example, Diamond-like carbon (DLC)/ILs composite solid-liquid lubricating coatings have been studied recently in space applications. Graphene is the building block of the most common macroscopic solid lubricant, graphite, which exhibits low friction and wear rates. Thus far, both experimental and theoretical results of the excellent friction of graphene nanosheets have been reported. In view of the excellent mechanical strength and the low friction of graphene nanosheets, graphene is very suitable as a load-carrying phase of IL-based composite lubrication films, and the composite films composed of graphene nanosheets and ILs will possess improved comprehensive tribological performance and meet the requirements of MEMS/NEMS and challenging space application. In this presentation, we review the fabrication, physical and chemical properties and tribological performance of ILs/graphene-based composite films. We also present its space performance under high vacuum and space radiation conditions. We further discuss relationship between chemical compositions, microstructure and tribological behaviors of the composite films.