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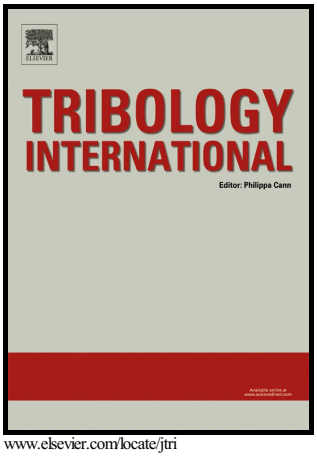
Abdul Wasy Zia, Zhifeng Zhou, Li Lawrence Kwok-Yan



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A preliminary wear studies of isolated carbon particles embedded diamond-like carbon coatings

Abdul Wasy ZIA*, Zhifeng ZHOU, Lawrence Kwok-Yan LI
Advanced Coatings Applied Research Laboratory (ACARL), Department of Mechanical and Biomedical Engineering, City University of Hong Kong, Hong Kong
*Correspondence: Office# +852 3442 2033. awzia3-c@my.cityu.edu.hk

Abstract

This article reports the preliminary wear studies of isolated carbon particles embedded amorphous diamond-like carbon (DLC) coatings. The isolated carbon particles are first created on top of DLC surface by plasma quenching. After repeatability, the particles are created simultaneous to DLC deposition and embedded in DLC at a controlled depth. The effects of embedded particles on DLC properties are analyzed by change in atomic structure, hardness, Young's modulus, friction coefficient, wear volume, and wear rate. It is observed that, a small amount of embedded particles increases the hardness by ~18% and reduces the wear volume by a factor of 3. Whereas, the friction coefficient increases by ~20% and hardness reduces around ~12% by embedding a large amount of carbon particles.

Keywords: Plasma; Quenching; Carbon; Embedded; Isolated; Particles; DLC; Wear

1. Introduction

Diamond-like carbon (DLC) coatings become popular due to their distinguished mechanical, optical, electrical, chemical and tribological properties. DLC coatings are widely used in most of the daily life products, such as mobile screens, bio-implants, solar panels, hard drives, mechanical components, and cutting tools etc. Recently, the importance of improving the coating life and reducing the friction between sliding and rotating surfaces such as pumps, engine valves, and gearboxes is well recognized by the industry.

Friction and wear studies of DLC coatings is an attractive topic for the last few decades. Wear volume and friction coefficient are generally influenced by hardness, shear strength and Young's modulus of the DLC coating. Usually, hard DLC coatings process lower friction coefficients [1]. Hence, to decrease the friction coefficient simultaneous to wear volume is an ongoing research issue. Several studies have been reported to describe different schemes to reduce friction coefficient and wear loss. These techniques include the formation of hybrid tribofilm [2, 3] where a combination of hard DLC and thin film or monolayer of lubricant provides a low friction and low wear. However, the interface design