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Numerical simulation and experimental investigation of tribological performance on bionic hexagonal textured surface

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Abstract

The numerical models for hexagonal textures of two orientations (θ=0° and 90°) have been established by using MATLAB and the corresponding specimens have been fabricated by laser texturing. The tribological performance has been examined both theoretically and experimentally to investigate the effects of geometrical characteristics and operating conditions. Overall, the experiments have verified the trends identified from the simulation and both show that the textured surface of θ=90° demonstrates better friction behavior than that of θ=0°. Moreover, the hexagonal textured surface with the area density of 25% can reduce friction coefficient up to 41%, compared to the control of smooth surface.

Keywords: bionic hexagonal texture, tribological properties, surface texturing, hydrodynamic lubrication

1. Introduction

It is known that topographic features on the friction surface play an important role in tribological performance. It has also been verified by numerical simulation and experiments that surface texturing is an effective measure to improve lubrication properties [1, 2]. A theoretical model based on the Reynolds equation was first established in 1996 to demonstrate the beneficial effects of textured surface under lubrication [3]. Since then, tribological investigations on textured surface have gained more extensive attention. To date, a broad range of applications of surface texturing have been implemented on various parts, including mechanical seals [4], thrust