Effect of coating on transmissions efficiency [Abstract]

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1. Introduction

The automotive industry is under increasing pressure to comply with stringent emission regulations. The primary function of the automotive transmission is to match the output of the power unit (internal combustion engine/ electric motor) to the vehicles speed/torque requirement. In passenger vehicles the automotive transmission is responsible for 5% of fuel energy consumption [1]. It is therefore desirable to improve the efficiency and longevity of the transmission system.

The tribological conjunction between mating gear teeth in such applications are subject to variations in slide roll ratios, shear, torque and contact pressure within the meshing cycle. The tribological surface-lubricant system therefore is subject to continual change, coupled with dynamic discontinuities such as misalignment which can cause significant increases of stress on the gear tooth flank. Modifications of tooth geometry such as crowning can be used to mitigate unwanted effects such as angular misalignment and edge stress discontinuities. Another method for mitigating unwanted phenomena is through thin, resistant coatings, such as Diamond-like-carbon. Such coatings are used due to the improved boundary friction characteristics, wear and chemical resistance. However the introduction of a coating to the surface-lubricant system can significantly change the tribological contact conditions and thus the operational performance, stability and efficiency. This alteration to the system should be accounted for within any predictive tools. This paper investigates the effect of coating on the prediction of transmission system parameters such as frictional power in comparison to polished isentropic gear steel surface.

2. Methodology

The high contact pressure, shear rates and bulk temperatures within the transmission leads it to a non-Newtonian mixed elastohydrodynamic regime of lubrication. Under this regime the contact load is carried by a combination of the elastohydrodynamic response of the lubricant and direct contact opposing asperities. A model for prediction of system parameters is adopted which accounts for system parameters of highly loaded thermos mixed EHL non-Newtonian contacts [2]. The friction generated within the contact is the sum of viscous shear of the lubricant and the boundary friction created by the contacting asperities. The EHL load carrying capacity generated within the elliptical contact formed by the meshing gear teeth is found using the analytical expression developed by Chittenden et al. [3]. While the contribution of boundary load carrying capacity from contacting asperities uses Greenwood and Tripp [4]. Surface specific measured topographical charaterisation is performed to provide surface and scale specific parameters.

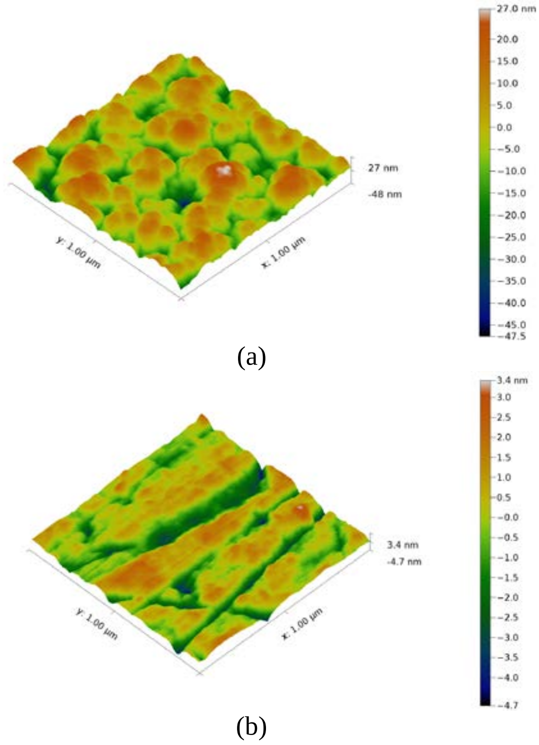

Figure 1 AFM image of the (a) Plasma Enhanced Chemical Vapor deposition (PECVD) coating (b) steel nanoscale surface topography

The use of surface specific measured topography data and an analytical model provides improved understanding of coatings within the contact of meshing gear teeth for automotive applications.

3. References

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