Flexibility and frictional characteristics of DLC and Si-DLC films deposited on nitrile rubber

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Abstract

The flexibility and frictional behaviour of DLC and Si-DLC films with and without Si-C interlayers were studied in this paper. The films were deposited onto nitrile rubber using a combination of a closed field unbalanced magnetron sputtering ion plating system and plasma enhanced chemical vapour deposition in Ar/C_4H_{10} plasma. Flex tests were used to determine the film flexibility. The frictional and wear characteristics of these films were investigated using a pin-on-disc tribometer for applied loads of 1 N and 5 N under conditions of dry and wet sliding with a stainless steel counterpart. The induced temperature rise during tribo-testing was used to determine the effect of frictional heating on the frictional behaviour of these films. Lateral cracking was observed for DLC film and Si-DLC film with and without Si-C interlayer after flex tests. More de-bonding was observed for Si-DLC film. The films generally showed excellent frictional results for dry sliding under normal load of 1 N and for wet sliding under normal loads of 1 N and 5 N. The improved film flexibility was related to enhanced adhesion as a result of the Si-C interlayer. Frictional heating was significant for tribo-testing performed under normal load of 5 N under dry sliding conditions. The induced surface temperature suggests that the influence of frictional heating of the structural transformation taking place within the wear track is minimal compared to the formation of wear debris.

Keywords: Coefficient of friction; DLC; Flexibility; Frictional heating; Si-DLC; Wear