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Influence of the thermal properties of carbon-based coatings on their application in tribological applications

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Carbon-based coatings and especially Diamond Like Carbon (DLC) coatings are widely used since many years in tribological systems with high loads and/or high pressures where friction and wear reduction is needed. However, DLC coatings have a poor thermal stability and start to graphitize at temperatures higher than about 300°C. While this graphitization limits the application of DLC coatings in high temperature applications, it also allows the outstanding running-in properties of these coatings.

In this work we investigated the thermal degradation of different DLC coatings (hydrogenated and non-hydrogenated) with a reciprocating pin-on-plate sliding wear test under dry running conditions in a temperature range going from room temperature up to 480°C. Even though most automotive applications are lubricated, starved lubrication might temporarily occur and lead to dry running conditions with high local contact temperatures which might exceed the thermal stability of DLC coatings. The tribological testing was completed by measurements of the depth-dependent coating hardness and the analysis of the structural properties of the DLC coatings by means of Raman spectroscopy.

In addition, we investigated the effect of the thermal properties of DLC coatings on the tribological properties of a lubricated contact using a two-disc tribometer and compared it to other coating materials. This analysis was completed by the measurement of the thermal conductivity of the different coatings.

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Keywords

DLC coatings

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graphitization

thermal conductivity

Automotive applications