KN1000

The effect of coating characteristics on the coating performance of a-C:H and ta-C films

Helena Ronkainen[1], Kenneth Holmberg[1], Anssi Laukkanen[1]

[1]VTT Technical Research Centre of Finland, Espoo, Finland

helena.ronkainen@vtt.fi

Diamond-like carbon (DLC) films cover a wide range of different carbon based coatings, starting from soft hydrogenated films to extremely hard hydrogen-free films. Due to the varying characteristics of DLC coatings, they have differing tribological properties that influence the performance and applicability. Coating properties greatly influence on the practical performance of the coatings in real applications. An interesting aspect is also the influence of tempering or aging of the coating on the performance. The coating performance of two different types of DLC films, namely hydrogenated amorphous a-C:H and hydrogen-free tetrahedral amorphous ta-C coatings, has been studied based on tribological testing and 3D finite element modeling (FEM). The practical scratch testing combined with 3D FEM modeling provided information on the stress and strain performance of the coatings. The results showed the influence of coating thickness and for the ta-C coating an optimum coating thickness was found.

In order to successfully apply DLC coatings it is important to understand the temperature and aging effects of the coatings. These effects are studied based on multi-scale modeling combined with practical testing. The multiscale modelling is a novel integrated approach combining material microstructural features modeled by FEM with thermal features modelled by constrain free energy (CFE) method on microscale and further combined with atomistic features modelled by molecular dynamic simulation (MDS) on nanoscale. Validation of the models is done on nano, micro and macro scale, e.g. the tribological performance of DLC coatings deposited several years ago is verified and compared to earlier results reported. The tribological test results combined with the modeling emphasize the importance of understanding the coated system and the interactions of coating characteristics, coating thickness and substrate properties for successful utilization of the DLC coatings.

Keywords
DLC
ta-C
a-C:H
tribo-performance