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Do silicon oxide doped DLC (SiO_x-DLC) films get a cure from the environment during sliding?

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Amorphous hydrogenated carbon (a-C:H) films are widely used as protective solid lubricant coatings in tribo-mechanical applications such as car engines, magnetic storage disks and biomedical implants. However, these films can exhibit low thermal stability and high residual stresses, and their frictional properties can strongly deteriorate due to changes in the gaseous sliding environment [1]. In the literature, silicon oxide doped diamond-like carbon (SiO_x-DLC) films, also called diamond-like nanocomposite (DLN), exhibit better thermal stability [2] and are less sensitive to the environment [3] than a-C:H films. A convincing model to explain the mechanisms responsible for the improved stability does not yet exist. This work aims to identify the origin of the unique macroscopic tribological properties of DLN films under different environments (ambient air, UHV, oxygen gas and hydrogen gas).

Friction experiments were performed with two linear reciprocating pin-on-flat tribometers, one operating in ambient air but allowing gas blowing around the contact, and one placed inside an ultra-high vacuum chamber allowing gas introduction up to 2 atmospheres and equipped with differential mass spectroscopy [4]. Ambient air tribometry tests using steel conterfaces provide evidence of the dependence of the interfacial shear strength on humidity, and tribotests carried out under UHV conditions indicated that the friction response is mainly controlled by the adhesive interactions between DLN film and the counterface.

In this talk, we will address a key question: does the presence of reactive gases prevent the formation of adhesive junctions by surface passivation, or does it affect the way these junctions are released? A combination of morphological observations and surface analyses are used to help us answer this question.

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