Influence of humidity on the tribological behaviour of W-alloyed DLC:H coatings

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Among tribological coatings, DLC (diamond-like carbon) has been preferentially selected for several mechanical applications since it can simultaneously present high hardness and low friction coefficient. Unfortunately this tribological behaviour is not universal in all environments. There is a great controversy in literature about the influence of the humidity content in the testing atmosphere on the friction coefficient of DLC coatings. Now, it is generally accepted that each type of DLC is a case and its tribological performance will depends on either its chemical composition (e.g. to include or not H or a metal) or the testing conditions. Thus, it is important to analyse and understand in which way the chemical composition of DLC coatings can influence their behavior when changes in the testing environment occur.

In this work, C-based films with additions of W and H were deposited by magnetron sputtering in a reactive CH_4-containing atmosphere. The depositions were performed in a 4-cathodes unbalanced magnetron chamber from TEER Coatings Lda. equipped with: 2 graphite targets, 1 puzzled W pellets incorporated graphite target and 1 Ti target for deposition of an adhesion interlayer. By varying the power applied to each target and the partial pressure of the CH_4 reactive gas it was possible to achieve DLC films with composition in W and H in the range from 0 up to 12 and 35 at.% respectively. The coatings were basically characterized concerning the chemical composition, structure, hardness and scratch-testing critical loads. Hydrogenated (~18 at.% H) and non-hydrogenated films with W contents close to 10 at.%, were selected for the tribological tests based on their characteristics. These films were then tribologically tested in standard conditions by using pin-on-disk. The relative humidity in the atmosphere was varied from 30 to 80 %RH. After testing, the worn samples were analysed by scanning electron microscopy and Raman spectroscopy, in order to Access the influence of W and H on the sliding mechanisms.