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Wear resistance of Carbon / Boron Nitride nanometric multilayers and photoemission microscopy (PEEM) analysis of their weartracks

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We have studied the tribological properties of multilayers composed of nanoscale hexagonal carbon (h-C) and hexagonal boron nitride (h-BN) layers. These two materials are soft and lubricant in bulk, with poor wear resistnace under high loads. However, when a stacking of nanoscale layers is formed, the wear resistance improves drastically, showing wear rates below 1x10-7 mm3/Nm. the C/BN multilayers were formed by sequential evaporation of (i) carbon and (ii) boron with a concurrent nitrogen ion beam. In this way, a series of multilayers with period between 3 and 80 nm is obtained [1]. Details on film preparation and characterization by SEM and TEM microscopies are discussed. The friction and wear resistance are evaluated by pin-on-disk tests under different conditions.
To perform a Photoemission Electron Microscopy (PEEM) analysis of the tribochemistry taking place on these multilayered films, erosion by pin-on-disk was performed to create a measurable weartrack where only a few of the topmost sublayers were exposed to the environment. In this way, layers with nanometric thickness appear as micrometric and nanometric bands along the sliding direction in the wear track. The spectroscopic analysis of these compositional features in the weartrack constitutes a perfect playground to evaluate the microscopy and spectroscopy capabilities of PEEM analysis.
Several interesting observations are made on the tribochemistry between the stainless steel balls and the C/BN film, among them the preferential reactivity of Fe towards boron and Cr towards C.
Reference
[1] R. Torres et al. Reversed texture in nanometric carbon/boron nitride multilayers, Carbon, 74, 374 (2014)

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