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Temperature dependence of the tribomechanical properties of DLC coatings deposited by magnetron sputtering

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Diamond Like Carbon (DLC) coatings have been recognized as one of the most valuable engineering materials for various industrial applications including manufacturing, transportation, biomedical and microelectronics. Among its properties, DLC has good frictional behaviour combined with high surface hardness, offering an elevated protection against abrasive wear. Nevertheless, DLC is very temperature-sensitive since its sp3-sp2 structure undergoes a graphitization process at high temperatures which deteriorates both hardness and the coefficient of friction. Information about the range of temperature where DLC loses its excellent tribomechanical properties still remains unclear. This is mainly due to the difficulties associated with the characterization of the mechanical and tribological behavior of thin-films at high temperature. In this work, we show the influence of temperature on the deterioration of the tribomechanical behaviour of various DLC coatings. All studied samples were deposited on AISI 304 stainless steel substrates using WC as a compliant layer between the substrate and the DLC film. Films were deposited by magnetron sputtering with a magnetic configuration optimized for C-based compounds using DC, DC-Pulsed and HIPIMS plasma excitation modes. The influence of the H concentration on the tribomechanical properties , some of them were deposited under different hydrogen atmospheres. The properties of the DLC films range from >30 GPa for low hydrogen concentration to very low friction with a higher content of hydrogen. A HiPIMS technique was used to improve the coating adhesion. Rockwell adhesion and nanoscratch tests show that the films exhibit excellent resistance to delamination.Finally, by comparing high-temperature indentation as well as pin-on-disk results for various films allows a better understanding of the key parameters influencing the temperature dependence of the tribomechanical behaviour.

Keywords
DLC
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