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Tribological properties of high sp3 content DLC thin films prepared by deep oscillation magnetron sputtering

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Future combustion engines will require thermal stability up to 500 °C and increased wear resistance compared with present day solutions. Piston rings and cylinder walls also involve extreme contact pressures that increase even more the materials demand. Hard tetrahedral DLC coatings (ta-c coatings) have a high percentage of sp3 carbon bonds, very smooth surface and very low coefficient of friction, showing good performance in mixed and boundary lubricated systems, all features that fit to the new demands.
Production of ta-c demands highly ionized physical vapour deposition (PVD) deposition techniques, such as Cathodic Arc deposition. The sp3 bond content depends critically on the bombardment of ions with hyper-thermal energy during the deposition. The main drawback of arc deposition process is the ejection of “macro particles” from the target that degrade film mechanical properties. Filtering the plasma overcomes the problem but is an expensive solution that also strongly decreases the deposition rate.
Conventional d.c. magnetron sputtering (dcMS) can deposit DLC films with smooth surface, however, they present a low sp3 bond content (up to 45%) and consequently lower film density and lower hardness (
In this work, DLC films were prepared by DOMS using Ar and Ar/Ne gas in the same deposition system in order to evaluate the potential of DOMS for hard DLC synthesis. The films were evaluated with XRD, UV Raman spectroscopy, SEM and nano-indentation. Coefficient of friction was obtained using pin on disk apparatus.

Keywords
DOMS
DLC
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