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Tribological and mechanical behaviours of Ti-containing DLC nanocomposite coatings in biological environment

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This study presents the influence of the addition of Ti to DLC coatings (with or without hydrogen) on the structural, mechanical and, mainly, tribological properties. The coatings were deposited in a four magnetron Teer sputtering device with two C targets and a Ti target in Ar atmosphere, on Steel and Si substrates. To deposit hydrogenated coatings methane was introduced in the discharge atmosphere. A Ti interlayer (300 nm) was applied to enhance adhesion between the films and the substrate.

The films were deposited in a range of 7-14 at.% Ti content. An amorphous structure was observed in all coatings and, increasing the Ti content, vestiges of crystallinity were detected, in both H-free and hydrogenated coatings. It was observed that with increasing Ti content, the adhesion of the coatings was better (scratch testing - loading range of 2-50 N and loading rate 10N/mm). The hardness measured in the doped coatings varied from 8 to 10 GPa, for the H-free films, and from 7 to 9 GPa for the hydrogenated ones.

Due to the excellent tribological properties, DLC coatings are used in a wide range of application. For this study, the sliding tests were aimed for biomedical applications. Therefore, the main aim was to analyze the interaction of the coating surface with bovine serum in order to understand their behavior in biological environment. The tribological tests were performed under dry and lubricated (Bovine Serum) conditions in a pin-on-disc wear test apparatus. Moreover, wettability tests were performed in order to support the tribological results. With the addition of Ti the increase of the contact angle (H-Free and hydrogenated coatings) was observed; all the coatings were hydrophobic.

Keywords

Ti-DLC:H coatings

Bio-tribology

Low friction

DLC lubrication

Biomedical application