Diamond-like carbon coatings deposited by the DC-pulsed PACVD method with active screen on Ti6Al4V substrates

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Diamond-like carbon (DLC) protective coatings were deposited on Ti6Al4V substrates using a DC-pulsed plasma assisted chemical vapor deposition (PACVD) technique with active screen and hexane (C_6H_{14}) as a precursor. In order to obtain a high adhesion of the coatings on the substrates, a thin amorphous hydrogenated silicon interlayer (a-Si:H) was synthesized using tetramethylsilane ($Si(CH_3)_4$) as a precursor. The microstructural, mechanical and tribological properties, as well as the corrosion resistance and adhesion of the coatings were determined. Additionally, bactericidal tests were performed using two bacteria (Escherichia Coli and Pseudomonas Aureginosa) and one fungus (Candida Albicans). This deposition technique allowed obtaining DLC coatings with excellent microstructural properties and with hydrogen contents less than 25%. The use of hexane as a precursor gas made it possible to achieve a high deposition rate of approximately 3 µm/h. The amorphous silicon interlayer allowed the internal stresses reduction (≤0.9 GPa) and, consequently, obtaining a high adherence of the coatings to the substrates, reaching critical load values higher than 42 N. The coatings obtained presented attractive mechanical and tribological properties, while the potentiodynamic polarization tests also showed a high protection of the coatings against the effects of corrosion. The DLC protective film increased the bactericidal properties of the substrate, making it attractive for biomedical applications. These results suggest that DLC protective coatings can be used in applications where hard surfaces, resistant to abrasive wear and corrosion, with low COF and high deposition rate are required.