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Study of DLC(N) film with nitrogen gradient on corrosion resistance of 321H stainless steel

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DLC films (a-C:H) present excellent properties influenced by the balance of the sp3and sp2 bonds that composes the film, but it presents low adhesion to metallic surfaces due to high compressive stress, in contrast to the low density of chemical bonds at interface of the films. Adhesion of a-C:H on metal alloys is influenced by the affinity of the chemical interaction between the interfaces [1]. The objective of this work is to study the effects of gradient deposition of the nitrogen-doped DLC film, to obtain films with good adhesion films and greater thickness, improving the corrosion resistance of the material. Polished and cleaned 321H stainless steel was placed in the sealed reactor, and plasma treatments were carried out by PECVD with a Pulsed-DC power supply. Plasma ablation cleaning was performed using 80%Ar/20%H2 for 60 minutes and 285 V, followed by the interlayer deposition using 70%HMDSO/30%Ar for 15 minutes and 500 V. Posteriorly, the DLC film was deposited using 90%CH4/10%Ar, while the nitrogen-doped DLC film (DLC(N)) was carried out using 70%CH4/30%N2. DLC film (DLC Grad) deposited by nitrogen gradient was carried out by decreasing the percentage of nitrogen in the DLC(N) film until a DLC film is formed. Films were characterized by metallography, defect analysis, and cyclic potentiodynamic corrosion test, to determine if the investigated treatments can be an alternative to improve the properties of studied materials. Metallographic analysis showed uniform layers, and the formation of the DLC film was identified by the presence of carbon, and silicon from the organosilicon film. Otherwise, DLC(N) film was identified by the presence of carbon and nitrogen, and DLC Grad film was possible to observe the gradual decrease in the amount of nitrogen. Analysis of defects has shown the presence of precipitates in the base material. These precipitates are mostly identified as titanium nitride which difficult the film deposition due to its ceramic characteristic. Analyzing the corrosion test, it is observed that the DLC(N) and DLC Grad film presented greater corrosion potential when compared to the base material and DLC film. This is justified by the presence of nitrogen in the films while it is more difficult for the solution to interact with the defects of the analyzed film when the element is present, and since DLC films do not have nitrogen, the corrosion focuses on these regions, harming the corrosion potential in relation to other samples. It is possible to conclude that the gradient film reduces the formation of defects and improves the corrosion resistance of the DLC film.