Mechanical and corrosion behavior of thick and soft DLC coatings

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The DLC coatings are chemically inert, have low friction coefficient and good wear resistance. Depending on H content and sp^3 bonds, they can be classified in "soft" or "hard" films. Although there are several publications about DLC, there are not many contributions about soft and thick coatings deposited on steels. In this work, the corrosion and mechanical behavior, so as the adhesion of DLC coatings are studied. The coatings, which are in fact silicon containing amorphous hydrogenated carbon films, were deposited by PACVD on nitrided austenitic stainless steel (duplex sample) and non nitrided austenitic stainless steel (coated sample). The films were characterized by EDS and Raman spectroscopy, hardness was assessed with nanoindenter and microstructure was analyzed by OM and SEM. To evaluate sliding wear behaviour and friction, pin on disk tests were performed. The abrasive wear resistance was tested using the ASTM G65-95 Dry Sand/Rubber Wheel test. Erosion tests were conducted in water and sand flux. The corrosion resistance was evaluated by the Salt Spray Fog Test and electrochemical tests in 3.5 % NaCl solution. The adhesion was tested using Scratch Test and Rockwell C Indentation.

The thickness of the DLC coating was about 36 μm, and its hardness was12 GPa. The coatings presented a low friction coefficient, about 0.09. In the abrasive tests, the mass loss was undetectable and in erosion experiments, the mass loss was reduced 42 %. Regarding the corrosion behaviour, the corrosion resistance in the Salt Spray Fog Test was good only in the duplex samples. In the potentiodynamic tests, the coating presented a passive behaviour, reaching 3 V above the corrosion potential without a noticeable increase in the density current. In potentiostatic polarization tests, the current density only increased after 8400 s at a potential of 2 V. The adhesion was acceptable only in the duplex sample and the critical load was higher in this sample than in the coated sample. The nitrided layer was a good interface for reducing the stresses and improving the adhesion.

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