

Characterization of thick and soft DLC coatings deposited on plasma nitrided stainless steel

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Thick and soft DLC coatings were deposited by PACVD with a DC pulsed discharge on nitrided and non nitrided austenitic stainless steel. The films were characterized by EDS and Raman, hardness was assessed with nanoindenter and the microstructure was analyzed by Optical Microscopy, SEM and XRD. To evaluate the wear resistance, pin on disk and abrasive wear tests were carried out. The adhesion was evaluated using Scratch Test and Rockwell C Indentation test. Corrosion behavior was evaluated by the Salt Spray Fog Test.

The films had high hydrogen content, over 40%, with a intensity ratio of the D and G peaks of about 1.26 and a low ratio of C-C sp³ bonds. The film thickness was about 25-27 μm, the hardness was about 6 GPa and the Young's Modulus was 36 GPa, though it can be considered a soft a-C:H film. In the pin on disc test, the friction coefficient under 0.59 GPa hertzian pressure with alumina as counterpart was 0.05 for the only coated samples and 0.076 for the duplex samples. These values resulted more than one order of magnitude smaller than the friction coefficient in the only nitrided sample, which was of 0.65. In the coated samples, the wear loss was impossible to measure.

In the abrasive test, mass loss was undetectable in both duplex and coated samples. But indeed the wear track showed a bigger damage on the coated sample than on the duplex one. The relative mass loss for nitrided sample compared with non-treated material was about 50%.

With respect to adhesion, the critical load was higher in the duplex sample (27.25 N) than in the only coated sample (16.3 N). Also in the Rockwell C indentation test (150 kg), the coating material surrounding the indentation was detached in both samples, but in the duplex sample, the detachment area proved to be smaller than in the coated sample.

Keywords

soft DLC
AISI 316L
wear
adhesion