Wear resistance of an Hyperlox Gold® coating over nitrided martensitic AISI 420 stainless steel

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Martensitic stainless AISI 420 steel was plasma nitrided and then coated with an Hyperlox Gold® coating (Cemecon), using the PVD magnetron sputtering technique in an industrial facility at Coating.Tech, Argentina. The coating is mainly AlTiN, covered with a thin layer of TiN to provide the gold colour. Duplex samples (nitrided + coated) were tested in wear comparing with only coated AISI 420 steel and with only nitrided steel. XRD, Nanoindentation, Raman, optical, electronic and confocal microscopy were used to observe the cross section and analyse the wear scars. Adhesion was studied in a Scratch Test following ASTM C1624 standard. Abrasive wear tests were conducted in a sand rubber wheel test (ASTM G65) and adhesive wear tests, in a rotational pin on disk machine using a 6 mm alumina ball as counterpart, and 500 m wear distance using three different normal loads.

Steel samples were heat treated to acquire the martensitic structure and 580 HV hardness previous to the plasma nitriding process which was carried out in an industrial facility at IONAR, Argentina in a DC pulsed 10 h process at 390 °C with 20% N_2-H_2 atmosphere. The nitrided layer was 10 μm thick, and the hardness was measured as 1180 ± 40 HV. The Hyperlox coating was about 3 μm thick and the TiN top coating 0.5 μm thick. Adhesion was good in all cases, but it was better in the duplex sample where 90 N was the critical load, meanwhile in the only coated sample, it was 60 N. In the abrasive wear test, both coated samples showed indetectable wear volume loss in a severe wear test with 130 N load. However, in the adhesive wear test carried out with a pin on disk results were unexpected.

With a low load (5 N), the nitrided samples had a better behaviour than the coated samples. At higher loads, 7 N and 10 N, the behaviour was inverse. Moreover, the duplex coated samples lost less volume at 10 N, more at 7 N and even more at 5 N. The discussion will show the influence of surface oxidation in the nitrided steel at low loads to diminish the friction coefficient and how the structural stability of the coating system and the trapped debris determines the wear behaviour in the coated samples. The stress distribution with depth is also considered.