Microstructure and corrosion behavior of TiN coatings deposited on nitrided stainless steel by PBII&D

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Austenitic stainless steels are widely used in food and chemistry industry as well as biomaterials because they have an excellent corrosion resistance but the low hardness limit their potential applications. Plasma nitriding is usually used to improve the tribological properties of these steels but not always corrosion resistance is maintained. TiN coatings are commonly used for hardening cutting tools and they are also corrosion resistant.

In this work, Ti-TiN bilayer coatings obtained by PBII&D on nitrided austenitic stainless steel in order to improve not only hardness but also corrosion resistance compared with the samples which were only nitrided.

AISI316L samples were DC plasma nitrided in an industrial equipment (IONAR S.A., Argentina) during 20 h at 420 °C with 20% nitrogen partial pressure and hydrogen. After that, they were coated by means of a DC cathodic arc running 130 A current discharge between a Ti cathode and the vacuum chamber employed as anode. The samples were placed 30 cm away from the cathode surface and was connected to 6kV negative pulsed bias voltage. TiN films were obtained employing a continuous nitrogen flux of about 25 sccm and a working pressure in the range of $1\text{-}3.10^{-2}$ Pa. The morphology and structural properties have been characterized by means of an optical microscope, scanning electron microscopy (SEM) and X rays diffraction (XRD). The coating adhesion was assessed by means of Scratch Test and Rockwell C indentation. The corrosion behavior was evaluated etching the samples with Marble reagent and by means of anodic polarization tests in NaCl solution.

Ti and TiN peaks could be identified in the XRD patterns of the coated samples, meanwhile, the XRD patterns of the nitrided samples showed the expanded austenite phase. SEM observation showed the presence of macroparticles in the layer structure and the film thickness was about 1 μm. The Scratch Test and Rockwell C indentation allowed determined that the film had a good adhesion. The PBII&D samples resisted the marble reagent attack and in the polarization experiment, presenting the best corrosion behavior.