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Development of a post oxidizing process over nitrided and nitrocarburized steels for wear and corrosion protection

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Electrodeposited hard chromium (EHC) coatings have been widely used for improving wear characteristics of engineering tools and components. In the electrodeposition process, in general solutions containing hexavalent chromium have been used, which is classified as a carcinogenic compound. The environmental concern on the use of this coating stimulated the research activities for alternatives of hard chromium. In addition, the crack pattern of the hard chrome surfaces can represent a problem for wear and corrosion resistance.
Plasma nitriding or nitrocarburizing plus oxidizing is a promising duplex process, which can replace EHC in low and medium alloy steels. In this work, AISI 1045 was nitrocarburized, AISI 4140 was nitrided, both in a DC Plasma industrial equipment, and they were oxidized as prost treatment in the same chamber. Surface layers were characterized by XRD, Raman, optical and electronic microscopy. Both groups of oxidized samples were tested in wear and corrosion experiments, comparing them with the base material and the nitrided/nitrocarburized steel without oxidizing. Pin on disk, abrasion, scratch test, salt spray fog and electrochemical measurements were carried out.
The results showed nitrided AISI 4140 is a better substrate for the oxide layer than nitrocarburized AISI 1045, regarding wear resistance. In the scratch tests, the oxide layer delaminated for lower loads in nitrocarburized samples than in nitrided ones. For both substrates, the oxide layer as post treatment was good for atmospheric corrosion resistance tested in salt spray fog. In accelerated corrosion tests, on the other hand, more than the oxide layer, the integrity of the nitrided/nitrocarburized compound layers and the surface finishing were determinant.

Keywords
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