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SHORT TIME ION NITRIDING OF AISI 420 MARTENSITIC STAINLES STEEL TO IMPROVE WEAR AND CORROSION RESISTANCE

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Plasma nitriding has become a powerful tool to improve wear resistance of stainless steels, and sustain or even improve corrosion resistance with an adequate selection of process parameters. This was achieved with the so called S phase in austenitic stainless steels, but corrosion results were not so promissory in the case of martensitic stainless steel such as AISI 420. Temperatures should be kept under 400 °C to avoid massive CrN precipitation and the width of the nitrided layer diminishes at that low temperature.

In this work, the route of the short treatment with high nitrogen or high temperature was selected, nitriding samples previously hardened by a conventional heat treatment. A wide nitrided layer, and good wear and corrosion results were obtained simultaneously.

A 5 hours treatment at 420 °C in a 20% nitrogen atmosphere resulted in a 15 microns modified layer. Wear resistance was improved between three and four times in erosion and sliding tests compared to the non nitrided material, heat treated and with a martensitic structure. Similar results were obtained with samples nitrided for 3-6 hours at low temperature (400 °C) but with high nitrogen partial pressure, 70%. The nitrided layer reached 10-12 microns. Nitrogen penetration depth was inferred from hardness depth profiles and reached almost 30 microns. The hardness depth profile was better in the case of 5 hours, 420 °C, compared with a traditional 10 hours treatment at 390 °C.

XRD revealed an expanded Fe- α layer, also revealed "white" with Vilella etching. Fe and Cr nitrides were detected in small quantities at the surface as well. Corrosion resistance was tested by salt spray fog test, anodic polarization curves, always comparing with a non nitrided material and a traditional 10 hours treatment. In both tests the samples treated in the short time duration had good results.

Keywords

ion nitriding
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erosion
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