Depth dependent phase transformation in steels treated with nitrogen plasma (Invited talk)

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Abstract

Low energy nitrogen plasma treatment of steels at high temperature leads to modification of the subsurface to significant depths owing to the diffusion of nitrogen. In this study, three types of steels with different Cr contents were plasma nitrided at 520 oC in a N2-H2 (80-20%) gas mixture for 24 hours. The studied materials with their chromium contents are: AISI 304 - 18 wt% Cr, En24 – 1.2 wt% Cr and SAE 8620- 0.5wt% Cr, steels. After plasma nitriding the thickness of the nitrided layer was measured to be 150, 600 and 600 microns for AISI 304, EN24, SAE 8620 steels respectively when treated under the same conditions. The modified layers were analysed for surface roughness, hardness and phase information. Thereafter, the layers were removed mechanically to certain depths and phases were determined. Potentiodynamic tests were performed on the samples having different thickness of modified layers to determine their corrosion behaviour. It was observed at near surface there is presence of CrN and γ-Fe4N phases but at larger depths there is presence of the expanded austenite (S phase) in AISI 304 stainless steel. Whereas no S and CrN phases were observed in En24 and SAE 8620 steels but the layer was predominant with γ-Fe4N and ϵ-Fe3N phases. However, irrespective of the absence of S phase, it was observed that modified layers formed in SAE 8620 and En 24 steels exhibited better corrosion resistance. Hence, it can be concluded that iron nitrides exhibit a noble behaviour for improved corrosion resistance. A detailed correlation between the phases formed and corrosion behaviour will be dealt in this study.

Keywords: Plasma nitriding, phase transformation, corrosion

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