Influence of inclusions on the corrosion attack of plasma nitrided austenitic stainless steel

Lisandro Escalada[1], Sonia P. Brühl[2], Sebastián Suarez[3],Agustina Guitar[3], Darina Manova[4], Stephan Mändl[4], Silvia Simison[1]

[1] INTEMA, CONICET- Universidad Nacional de Mar del Plata, Argentina
[2] Universidad Tecnológica Nacional, Fac. Reg. Concepción del Uruguay, Argentina
[3] Dept. Materials Science & Engineering, Saarland University, Germany
[4] Leibniz-Institut für Oberflächenmodifizierung, Leipzig, Germany

ssimison@fi.mdp.edu.ar

Abstract

Austenitic stainless steels are well known for their good localized corrosion resistance. They are commonly employed in components and instruments in the food and beverage, as well as chemical, oil and medical industries. However their use in some applications is limited due to their poor tribological properties. In the last years, this kind of steels have been treated with different plasma assisted methods to modified their surface and make them suitable for more applications.

The samples were treated by DC pulsed plasma nitriding, low energy ion implantation (LEII) and plasma immersion ion implantation (PI3). Those treatments were performed on samples cut from a 316L bar, parallel and perpendicular to the maximum deformation direction. The nitrided layer was characterized by means of DRX and SEM/EDS. Hardness profiles were obtained on cross sectioned samples.

The localized corrosion resistance of 316L nitrided is analyzed and related to the nitrided layer thickness and to the inclusions present in the base metal. The plasma treatment was performed below 430^{o} in order to avoid the precipitation of CrN, which would compromise the corrosion resistance. Corrosion was evaluated by means of cyclic anodic polarization curves in 3.5% NaCl solution. The effect of inclusions was studied with FIB/SEM, optical and SEM observation of cross sections of the corroded samples.

It is well known that in non-surface treated austenitic stainless steels, the inclusions are pit nucleation points. In contrast, for the nitrided samples it was found that the inclusions dissolve and act as a canal between the electrolyte and the base metal below the nitrided layer. Although only minor corrosion is detected on the surface, an extensive attack is found underneath the nitrided layer when observing transversal cuts. Possible explanations are proposed.