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Hydrogen incidence on tensile strength behavior of AISI 316L stainless steel

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Most paper in literature are devoted on the effect caused by chromium carbides on the tensile behaviour of stainless steels, for example, it is known that the precipitation of M23C6, M6C and sigma phase are harmful under certain operative conditions, although there are only few papers related with hydrogen embrittlement in type 316L stainless steels. Even though hydrogen slightly modifies the mechanical behaviour of these stainless steels, it should be considered to avoid significant economic losses. The aim of this work is to evaluate the effect on mechanical response of hydrogen charged AISI 316L stainless steel samples. To achieve homogeneous carbides precipitation, specific thermal treatments were conducted on as-received samples. Then three sets of samples were considered to carry out tensile tests. Before that, a group of heat-treated samples were hydrogen charged, in a 1N H2SO4 electrolytic solution with 0.25 g/L NaAsO2 as hydrogen promoter agent, using graphite anode and a constant current density of 35 mA/cm2 for 3.5 h. After tensile tests, the resulting fracture surfaces exhibited mixed ductile-brittle behaviour in hydrogen charged samples in comparison with the ductile morphology obtained in uncharged ones. In addition, in hydrogenated samples cracks were found associated with fine chromium carbides, while ductile well-developed dimples were found in uncharged samples. In coincidence, there was a ductility loss in electrolytic hydrogen charged samples, which was not observed in those uncharged ones. In order to identify hydrogen- carbides interactions, a selective metallographic technique made it possible to find grain boundaries and carbides/matrix interfaces as the main hydrogen traps. Furthermore, differential scanning calorimetry (DSC) tests were performed to obtain hydrogen desorption temperatures. Results allowed to settle that those carbides developed during thermal treatments are responsible for deleterious hydrogen trapping that may cause mechanical failure on AISI 316L stainless steel.

Recent Publications

1. M N Delpupo, M N Inés, C A Asmus, G A Mansilla. Estudio del ingreso de hidrógeno en acero electrocincado mediante análisis térmico. Avances en Ciencias e Ingeniería. 2020; 11(3): 71-79

2. Graciela A Mansilla, Mariano N Inés, María Noelia Delpupo. Analysis of hydrogen behavior in high strength steels joints welded by smaw. Recent advances in welding. 2020

3. María N Delpupo, Mariano N Inés, Graciela A Mansilla. Influence of electroplating stages on hydrogen pickup in SAE 1005 steel. Advanced Materials Proceedings. 2018; 3(5): 356-360.

Speaker Biography

Mariano N. Inés, was born in the year 1985, he received his Metallurgical Engineer degree at the National Technology University of San Nicolas (UTN-FRSN), Argentina. He is currently professor and researcher at the UTN-FRSN, Argentina. His work area is related with hydrogen embrittlement of steels and its alloys. Currently he is working on his PhD in engineering at the Physical Metallurgy Laboratory of the UTN-FRSN.

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