Electrochemical investigations of the effect of the Sensitization of Nitrogen Stainless Steels

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Introduction.

Austenitic stainless steels have on generally high level of corrosion resistance, good mechanical resistance, work ability, and the possibility to obtain various specific combinations of properties by different compositions. However, these steels can become sensitized to intergranular corrosion (IGC) after undergoing treatment in the temperature range between 700 K to 1100 K, as result of microstructural changes at grain boundaries (GB)[1,2]. The critical factor on the resistance of SS to IGC is the $M_{23}C_6$ carbide precipitation on GB. The sensitization to IGC in austenitic SS could be reduced with the addition of nitrogen.

The aim of the present work is establish the change in corrosion resistance of two different stainless steels with nitrogen after different sensitization treatment.

Experimental.

The chemical composition of the investigated steel, namely JJ and JN are given in Table I. Both steels were annealed in the temperature range 873 K to 1173 K for 0.6 Ks to 60 Ks, in an argon atmosphere and then water quenched. Prior to corrosion resistance experiments, the sensitized specimens were polished with emery papers and with a fine alumina suspension (0.03micras), degreased with acetone in an ultrasonic cleaner and washed with distilled water. After this pretreatment, the specimens were immediately placed in a test cell.

Electrochemical measurements were carried out at room temperature in a glass cell containing 0.5M Na_2SO_4 + H_2SO_4 (pH=1-5). A stream of highly purified nitrogen gas was bubbled into the solution during the electrochemical experiments. The counter and reference electrodes were a carbon rod and saturated calomel electrodes, respectively. The controlled potential experiments were performed using a Potentiostat-Galvanostat Autolab controlled from a PC.

Results.

Figure 1 shows a typical potentiodynamic polarization curve obtained for JJ SS, with aging temperature and time of 1073 K and 60 ks, in Na_2SO_4-H_2SO_4 solutions of different pH. The corrosion potential being shifted to more positive values and the corrosion current being higher. Figure 2 shows the variation of the corrosion rate with the pH for of JN SS (1073 K, 973 K and 60 ks) and JJ SS (1073 K, 973 K, 18 ks) which indicates higher anodic dissolution rates with the decrease of the pH. JJ and JN SS shows a higher corrosion rate with the increment in the temperature and time sensitization treatment. They have been found susceptible to dichromium nitride (Cr_2N) precipitation during thermal exposure. Sensitization susceptibility by Cr_2N precipitation causes enhanced anodic dissolution in acid electrolytes

Tabla 1. Composition of stainless steel samples (wt%).

Element	C	Si	Mn	P	S	Ni	Cr	Al	Mo	N	Fe
JJ	0.04	0.97	3.88	0.02	0.01	15.07	24.32	0.02	---	0.32	55.35
JN	0.025	0.48	10.13	0.02	0.01	11.79	12.01	---	4.94	0.236	57.66

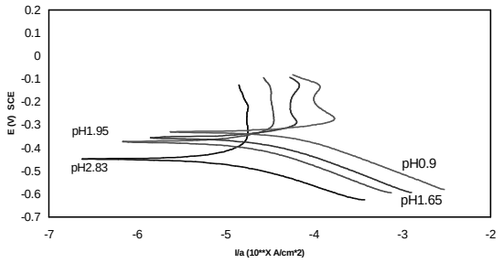

Figure 1. Tafel polarization of JN(1073 K, 60ks)

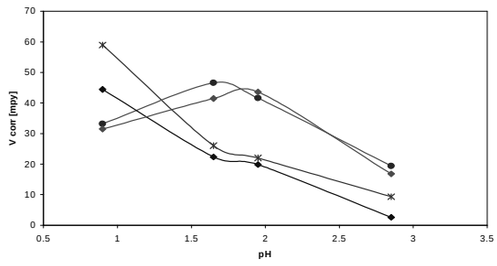

Figure 2. Variation of corrosion rate with the pH solution.

Reference.

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