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Effect of the sensitization in stainless steel UNS S30400

G. González-Mancera,* V. Cortés-Suárez,** L. González-Soledad,** L. Mas-Gutiérrez** and E.O. Núñez-Morán*.

*Universidad Nacional Autónoma de México, Depto. I.Q.M., Fac. de Química, circuito de los institutos Edif. "D", Ciudad Universitaria, México, D.F., 04510. ggm@servidor.unam.mx
**Universidad Autónoma Metropolitana, Depto. de Materiales, Av. San Pablo No. 180, Col. Reynosa, Tamps, México, D.F.,02200, vjcs@correo.azc.uam.mx

The austenitic stainless steels are an attractive material because of their outstanding properties such as corrosion resistance, weldability and high strength. However, when these austenitic stainless steels are exposed in the temperature range between 500°C and 800°C, the phenomenon of the sensitization appears, which is the main cause of the corrosion of these steels [1-3]. In this investigation, the sensitization behavior of the stainless steel UNS S30400 was studied using scanning electron microscopy and electrochemical techniques.

The chemical composition of the stainless steel UNS S30400 was obtained by means of energy-dispersive X-Ray spectroscopy (EDS) to be: Fe - 19% Cr - 7,9% Ni - 0,9% Mn - 0,31% Si - 0,07% C. The Vilella chemical etchant was used to reveal the microstructure of the steel, which was observed in a JEOL JSM-5900 low vacuum scanning electron microscope. Coupons of 6 mm diameter by 10 mm length were solution annealed at 1050 °C for 1 hour. Sensitization of the coupons was carried out at 650 ºC for 1, 10, 100 and 300 hours to promote the precipitation of chromium carbides. To determine the degree of sensitization and the corrosion density, the potentiodynamic and Taffel electrochemical tests were made. The solution test was 0.5M H_2SO_4 + 0.01M KSCN at 30°C.

It was determined that the corrosion rate increases with sensitization time until 100 hours (Fig.1), after which the corrosion rate holds constant. In addition, it was observed that the degree of sensitization (DOS) increases with time (Fig. 2), reaching a maximum value at 10 hours of treatment, after which DOS begins to decrease. The microstructure of the sensitized stainless steel showed that to 1 hour of treatment, the process of intergranular corrosion dominates; this is corroborated with the value of the DOS. To 300 hours, it was detected that the steel had formed twinning of annealed and precipitation of chromium carbides as in the grain limit as in the twinning. The precipitated chromium carbides in the grain limit were of the $Cr_{23}C_6$ type and the precipitated carbides in twinning were of the Cr_7C_3 type [4,5]. Subsequently the presence of precipitated carbides explains the reduction in the DOS, appearing as a transition of intergranular corrosion to uniform corrosion.

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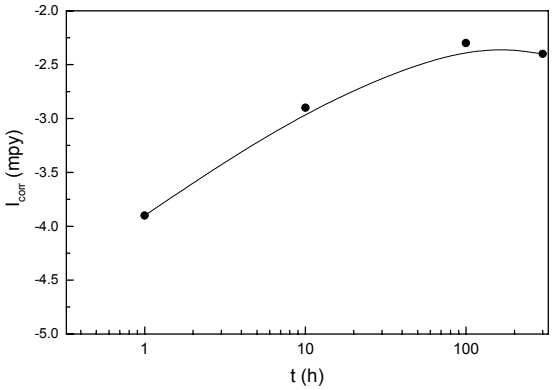

Fig. 1 Effect of the sensitization time on the corrosion rate.

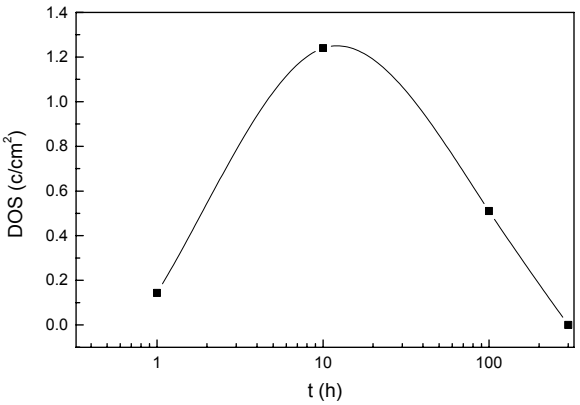

Fig. 2 Effect of the time on the degree of sensitization.

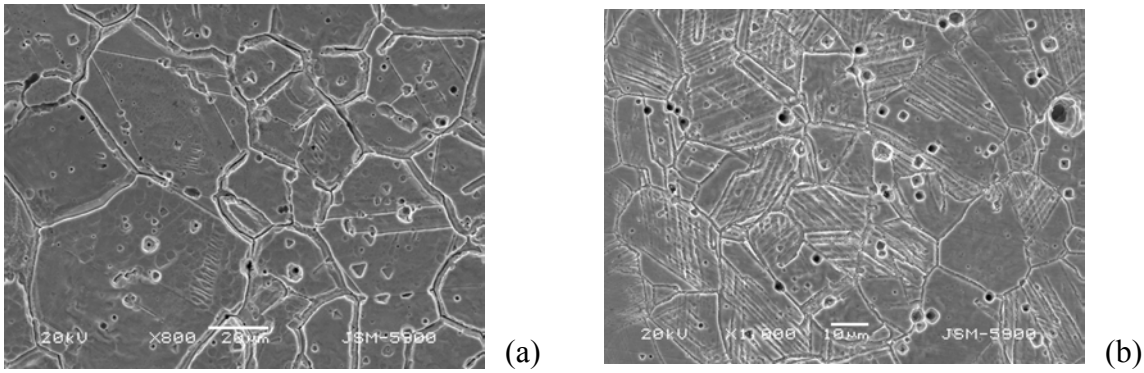

Fig. 3 SEM microphotography showing microstructure after (a) 1 h and (b) 300 h of sensitization.

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