

SVET study of the Corrosion of Thermal Scales Formed on AISI 1095 and AISI 52100 Steels.

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Introduction

Aiming to elucidate the chemical descaling of thermally produced oxides during the hot-rolling of steels, laboratory and industrially produced scales were analyzed by different electrochemical techniques, as Scanning Vibrating Electrode Technique (SVET) and voltammetry under controlled illumination, as well as micro-characterization techniques as low energy EDS elemental analysis with the use of mineral standards and μ -Raman spectroscopy.

Experimental

Specimens of AISI 52100 and AISI 1095 steels industrially hot-rolled or thermally oxidized in a laboratorial oven (5 min at 900°C) were used for the electrochemical characterization. SVET (Applicable Electronics) measurements and voltammetry were carried out in 0.01 molL⁻¹ NaCl and 0.01 molL⁻¹ HCl solutions at 25 °C. The reference electrode was a Ag/AgCl-electrode in 3.5 KCl. Potentiodynamic experiments were performed at 10 mVs⁻¹.

Results and Discussion

Fig. 1 shows voltammetric scans on the polished and thermally oxidized AISI 1095 in aqueous 0.01 molL⁻¹ HCl with a scan rate of 10 mVs⁻¹. The curve obtained for the polished steel shows a small peak at ca. -250 mV leading to the uniform dissolution potential region, while the oxidized steel shows two anodic peaks (-400, -260 V) leading a passive plateau, meaning that the thermal oxides, FeO and Fe₃O₄ may be further oxidized to Fe III species.

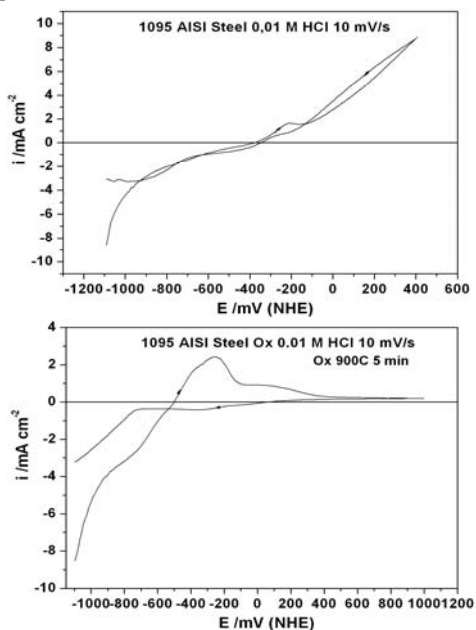


Fig. 1 *i* vs. *E* curves of oxidized (5 min at 900 °C) and polished AISI 1095 steel in 0.01 molL⁻¹ HCl.

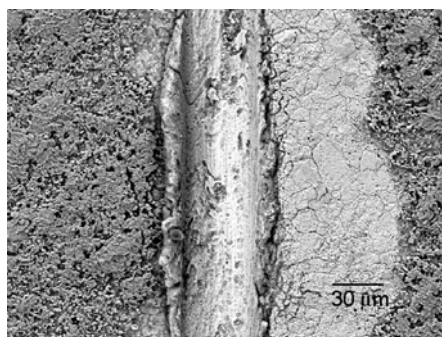


Fig. 2 Detail of Scratch on the oxide layer where SVET was measured, after 1h exposure in 0.01 molL⁻¹ HCl.

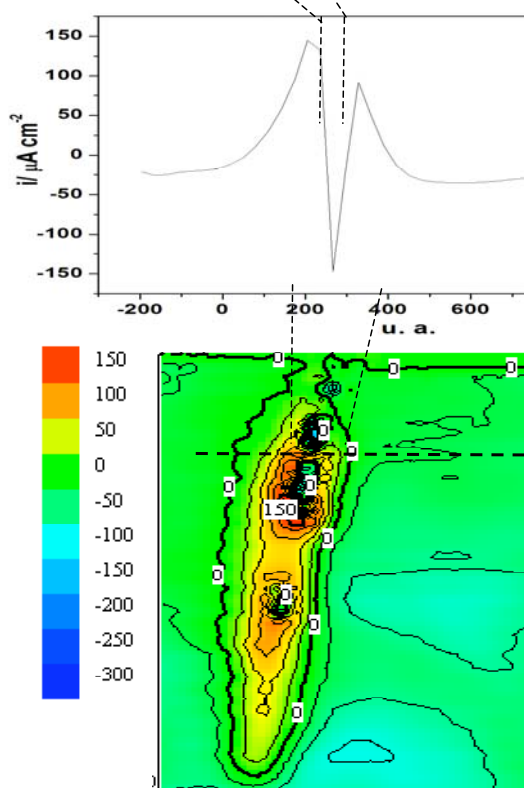


Fig. 3 SVET measurements of sample in Fig. 2 after 20 min exposure in 0.01 molL⁻¹ HCl.

Fig. 2 shows that after 1h exposure in the HCl solution the region previously covered with oxide was more intensively attacked than the bare scratched metal surface with the removal of the scales and grain boundary attack. This is confirmed by the current line scan of Fig. 3 showing cathodic currents inside the scratch. Apparently the anodic dissolution region is located at the oxide walls inside the scratch, leading to the delamination of oxide. Much larger cathodic areas are observed at the surface of oxide.