

Effect of coatings obtained by sputtering of chromium catode on the corrosion resistance of AISI H13 steel

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Abstract. Corrosion resistance of coatings obtained by sputtering a chromium target were evaluated. The films were deposited on substrates of disk-shaped AISI H13 steel. By means of potentiodynamic polarization curves were able to determine the current density vs. potential for the coated and uncoated substrate and the difference in the corrosion potential E_{corr} . All samples with coating showed an increase in E_{corr} respect to substrate. The electrochemical tests were conducted in an electrolytic solution of 3% NaCl.

1. Introduction

To carry out the corrosion behavior, it has been implemented in some direct current electrochemical techniques such as polarization resistance or linear polarization and potentiodynamic polarization curves [1-3], also techniques of alternating current are used as electrochemical impedance spectroscopy (EIS) [4-6]. The potentiodynamic polarization curves or Tafel curves are used to characterize different types of metals, this technique generates a semilog plot where the polarization curves are located. Tafel technique is a destructive technique from interface point of view since it gets it messy, which causes the movement of ions which changes the state of equilibrium of the interface [1, 7, 8].

2. Experimental

The material used was AISI H13 steel, whose chemical composition is: 0.39% C, 1.0% Si, 0.4% Mn, 5.3% Cr, 0.9% V, 1.3% Mo [8]. This steel was selected because it is suitable for nitriding and coated by PVD. This steel provides good balance of toughness, high resistance to cracking caused by thermal shock and resistance to tempering, combined with moderate wear resistance.

The evaluation of the corrosion resistance of the samples was carried out with a Gamry Potentiostat Model PC4. The system consists on a flat electrochemical cell, incorporating Ag / AgCl as reference electrode and a platinum electrode as counter electrode. The electrolytic solution used for the tests was 3% NaCl. The polarization Tafel curves were carried out by scanning the potential between -300 mV and 300 mV around the equilibrium potential with a rate of 1 mV/s.

3. Results and discussion

The films studied presented different colors, M1 yellow, M2 Coffe, M3 and M4 dark gray.



The figure 1 shows the potentiodynamic polarization curves obtained for different samples, you can observe that for all films the corrosion potentials were more positive than the substrate, which enables to state that its thermodynamic stability was enhanced. The corrosion currents results shows lower values to the films than the uncoated material, which corroborates the values obtained in the corrosion rates, which are lower for steel coating than uncoated steel, with these results it can be concluded that this treatment improves the performance of the test pieces front of corrosive processes.

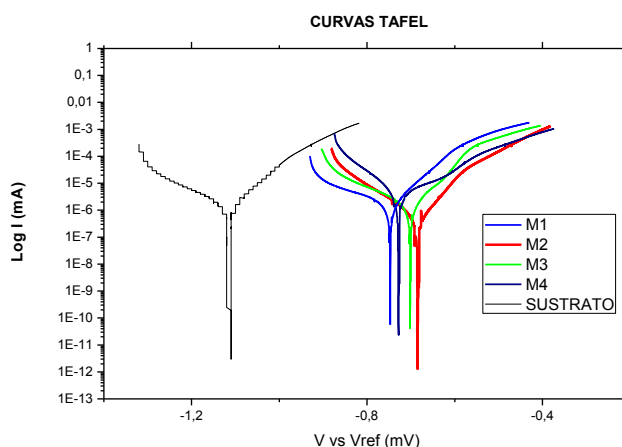


Figure 1. Potentiodynamic polarization curves.

Table 1. Parameters obtained from the Tafel curves.

Parameter	Ecorr (mV)	Icorr (μ A)	Corrosion Rate (mmpy)
Substrate	-1110	1.53	7.98E-01
M1	-747	0.692	3.53E-01
M2	-683	0.21	1.07E-01
M3	-701	1.13	5.75E0.1
M4	-727	0.353	1.80E-01

4. Conclusions

The results show that all coatings obtained allow to increase the corrosion resistance of steel AISI H13, as able to increase the corrosion potential of about 300 mV and decrease the corrosion current in all cases. Although the Tafel curves obtained showed no passivation areas, it was observed that the treatment improves the properties of the steel.

References

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