

Study of Mild Steel Corrosion in a Na_2SO_4 Electrolyte by Electrochemical Noise Measurements: Analysis of Data by Chaos Theory.

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ABSTRACT

Electrochemical techniques as Polarization Resistance, and Electrochemical Noise, were used to study the corrosion behavior of mild steel samples in Na_2SO_4 aqueous solutions (pH \approx 7) at room temperature. In order to analyze the corrosion mechanism the Power Spectral Density, PSD, was obtained using the classical methods MEM and FFT from noise measurements, both potential and current. In the present work we also analyze the time-series obtained by noise measurements in the context of chaos theory. The maximum Lyapunov exponent, correlation dimension, probability distribution and strange attractors of electrochemical noise measurements on AISI 1020 steel have been examined in order to characterize the system, in terms of regular, stochastic or chaotic behavior according to chaos theory. Finally, a comparison between the different electrochemical forms of analysis is also presented.

Figure 1, shows both, the time series of potential and current for mild steel immersed in 1.0% sodium sulfate solution.

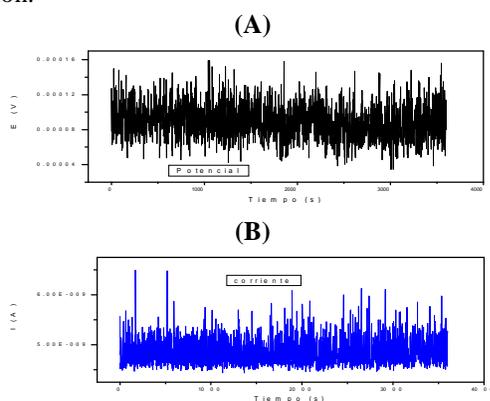


Figure 1. Time series of mild steel in 1.0% Na_2SO_4 solution, (A) Potential and (B). current.

From this type of data it is possible to generate the so called “system’s strange attractor” (see Figure 2) which is a representation in their phase-space. It is possible to note an arrangement of dispersed points; by means of this type of plots it is possible to classify the dynamic system as stochastic, random or chaotic system. In this paper, the system $\text{Fe-H}_2\text{O-SO}_4^{2-}$ shows different behavior. According to the parameters analyzed it is possible to say that this system in particular has a random behavior.

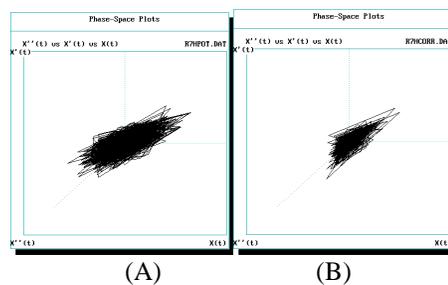


Figure 2. Strange attractors obtained from electrochemical noise measured on the mild steel immersed in a 1.0% sodium sulfate solution: (A) potential and (B) current.

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