CONTRIBUTION OF ACOUSTIC EMISSION TECHNIQUE TO STUDY THE ALUMINUM BEHAVIOUR IN AQUEOUS ALKALINE SOLUTION

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The electrodissolution of pure aluminum and aluminum alloys in KOH solution or in KOH solution with inhibitors has been studied with various technics. EIS and polarization measurements on rotating disk or cylinder electrodes were the technics the most widely used in the past (1). Indeed, using a non-stationnary electrode for kinetic measurement presents the advantage to control mass and heat transfer.

The need for a technique suitable to provide such information made us consider the application of Acoustic Emission (AE) technique for aluminum behavior in situ monitoring while immersed in concentrated KOH solution.

The first publications dealing with in situ electrochemical processes monitored by the AE technique appeared in 1983-1984 (2), followed by several other investigations (3-4). They establish the possibility to distinguish the different physical phenomena that can take place simultaneously on an electrode surface during electrochemical operation. We applied this technique to evaluate the corrosion behavior of pure aluminum in alkaline electrolyte.

The AE device (fig 1.) consisted of a piezoelectric sensor coupled with the aluminum sample using a spring, a preamplificator and an acquisition device. The aluminum sample was attached to the bottom of a classical electrochemical cell. Thus, we can study the evolution of the acoustic emission for aluminum in different media, during various electrochemical processes like open-circuit potentiel or polarization measurement.

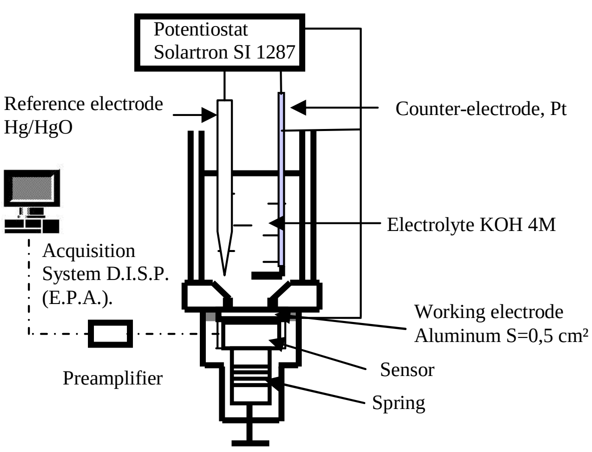

Fig. 1. Experimental device.

During the corrosion, different processse may take place on the aluminum surface yielding different acoustic signals. The waveforms, number of events hits and characteristic acoustic parameter were computer controlled as detected, and processed parallely to the electrochemical parameters, as shown on Fig. 2.

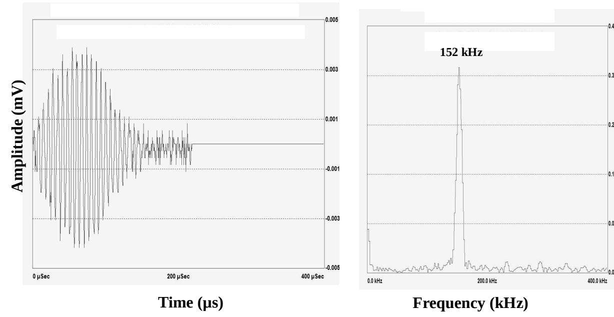

Fig. 2 Example of an acoustic signal and its Fourier transform.

For each detected AE signal, different parameters, e.g. peak frequency (frequency at the maximum of the fourier transform of the salve), amplitude, duration, energy, number of events, etc., are monitored.

Thanks to these parameters and their statistic treatment with neural network, we followed and discriminated all the differents physical processes link to the elecrochemical steps of the corrosion, such as release of hydrogen bubbles (correspondig to signal form of Fig. 1.), or oxide films growth.

As an example we studied the open circuit potentiel of an 4N aluminum sample immersed in a 4 M KOH solution. Fig. 3 shows different steps during time, which can be correlated with various characteristics of the AE signal evolution like number of hits during time.

The acoustic signal evolution aslo shows that this technique can reveal phenomena that cannot be observed solely following the electrode potential (Fig. 3).

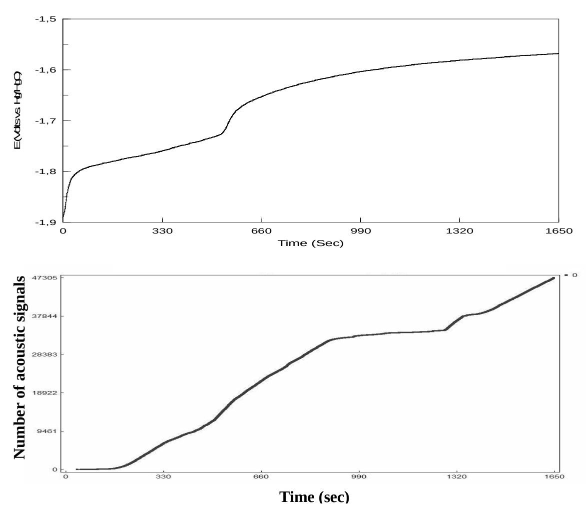

Fig. 3 Evolution of OCP and number of acoustic signal vs. Time.

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