APPLICATION NOTE

Corrosion AP-C04

INVESTIGATION OF GALVANIC CORROSION BETWEEN DIFFERENT METAL COUPLES BY ZRA METHOD WITH ORIGAMUX MODULE

In this application note, galvanic corrosion between different metal couples like Zinc and Aluminium, copper were studied through ZRA method on OrigaMux module. The results were compared and discussed in the following pages.

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INTRODUCTION

Zero Resistance Ammeter (ZRA) is an electrochemical method for galvanic corrosion studies in which the current is measures passing trough two different metals while imposing zero potential between them.
The measured current represent the galvanic corrosion current and could be analyzed as a factor of corrosion phenomenon and the level of protection of sacrificed metal.

In this application note OrigaMux module was used for performing ZRA test on different metals sample sequentially (Figure 1).
OrigaMux is a multiplexer module in accessories group of Origalys products. This module contain 8 cells for connecting electrodes and samples, by which users can run electrochemical tests sequentially.

Figure 1: OrigaMux module connected to OrigaFlex potentiostat

PARAMETERS

OrigaMux module works with OrigaViewer software, so DriveUnit is needed as power supply. The potentiostat used for OrigaMux module could be: OGF+500, OGF+01A, OGF+05A, OGF+10A or all OrigaFlex classic with or without impedance module.

While the package of DriveUnit+Potentiostat+OrigaMux is connected to OrigaViewer software, there is needed to define proper "Sample" for the potentiostat and for the Cells of OrigaMux respectively enabling it to work correctly.

NOTE: For more information about how to define the parameters and hardware connection using OrigaMux module, kindly refer to technical note number 01 in our website: https://www.origalys.com/Files/120087/241808660738145.pdf

ZRA METHOD

The parameters of ZRA test are shown in figure 2:

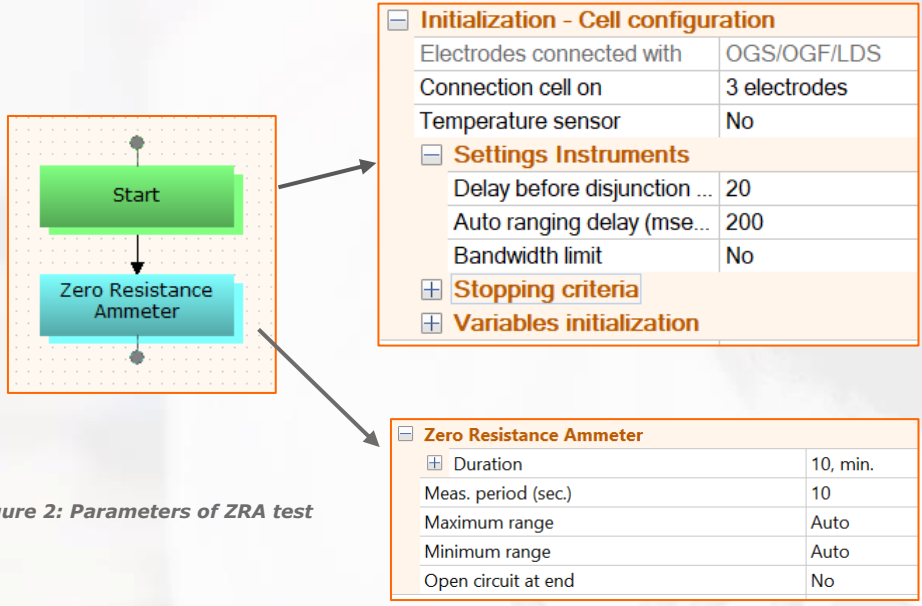

Figure 2: Parameters of ZRA test

Duration of ZRA test is considered as 10 minutes, and the loop for repetition of test is defined (for example 100 times).

It means when the first test of ZRA on OrigaMux cell is finished, it will passe to next cell, but the potential between working and auxiliary electrode will be maintained on 0V till end of all loops for all cells.

RESULTS AND DISCUSSIONS

When the ZRA tests finish on all cells, it is needed to extract and analyze the data and investigate the galvanic corrosion current following steps below:

Figure 3: Merged ZRA curve gained from cell OrigaMux after 100 cycle of loop

A – Extract data to OrigaMaster software

B – Overlay all ZRA curves gained on one cell or OrigaMux

C – Perform "process" to have a unique ZRA curve

D – Comparing merged ZRA curves of all cells

RESULTS AND DISCUSSIONS

Figures 4 to 6 are examples of ZRA curves on different samples illustrate different galvanic coupled metals.

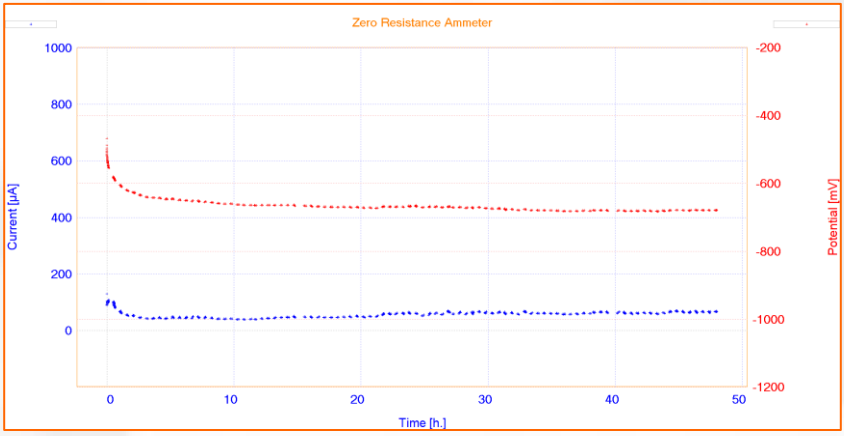

Figure 4: Merged ZRA curve gained from the coupled metals carbon-steel and stainless steel 304

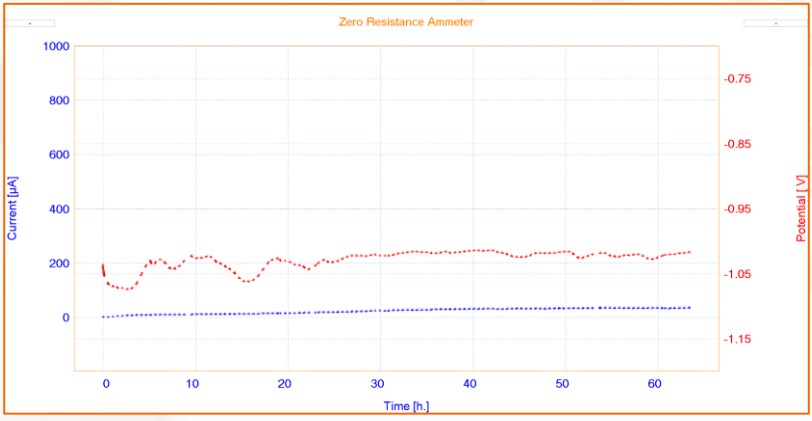

Figure 5: Merged ZRA curve gained from the coupled metals Aluminium and Zinc

RESULTS AND DISCUSSIONS

In all couples, the more active metal was considered as anode and working electrode. The potential in all curves is shown on red color which indicates difference of potential between working and reference electrode.

It could be seen from the curves the galvanic current passed trough two metals and the higher value of current indicates more corrosion of sacrificed metal which is considered as anode.

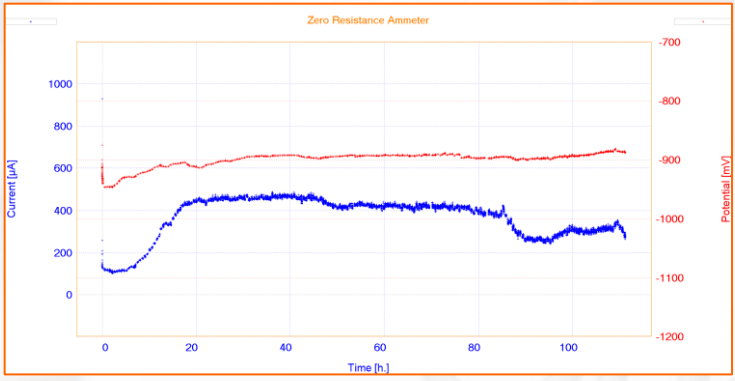

Figure 6: Merged ZRA curve gained from the coupled metals Copper and Zinc

INSTRUMENT AND ELECTRODES

Figure 7: OrigaFlex OGF+01A + OrigaMux

TEST SETUP	
Samples	Plates of Carbon-Steel, Stainless steel 304, Copper, Zinc and Aluminium (all 2 x3 cm)
Electrolyte	NaCl 3.5 %
Working Electrode (WRK)	Pt tip Ø2mm EMOGTPTD2CIAL
Instrument	OrigaFlex OGF+01A + OrigaMux
Software	OrigaViewer 2.0.0.9

Figure 8: Electrode cable for connection between OrigaMux cell and samples and electrodes