

# ELECTROCHEMICAL NOISE ANALYSIS FOR THE UNDER-FILM CORROSION OF POLYMER-COATED IRON

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## INTRODUCTION

The authors have investigated the time variations of potential of the polymer-coated iron during the de-lamination period in sodium chloride solution and then detected fluctuations of the potential. For the purpose the monitoring of localized corrosion, the mechanism of the noise generation is studied by analysis of current noise appeared at the potential of 0.6V vs. SSE with SEM observations. The spectrum analysis of the potential noise was also attempted for polymer-coated iron during immersion period in sodium chloride solution.

## EXPERIMENT PROCEDURES

The iron samples offered for this experiment had 99.5% purity and 0.3mm thickness. The samples were polished by #1000 of emery paper and rinsed in acetone and ethanol solvents for the purpose of degreasing as pretreatments. The test solution was 0.5mol/l sodium chloride solution. The surfaces of samples were observed with scanning electron microscope before and after measurements. Time variations of the potential and power spectrums were measured by potentiostat and FFT spectrum analyzer, respectively. Galvanic current and corrosion potential were measured with the short-circuited electrochemical cell simulated the anodic and cathodic blister parts, respectively.

## RESULTS AND DISCUSSION

The fluctuations of corrosion potential, or potential noise, appeared during a polymer-coated iron electrode being immersed in a sodium chloride solution. Under this condition, corrosion blisters developed at an interface between a coating layer and an iron substrate.

On the electrode used for this measurement, solely anodic blisters were formed. The places on the iron substrate where the anodic blister formed were covered with oxide films, and the traces of pitting were found on the films(Fig.1).

In order to investigate the electrochemical process of the potential noise, the fluctuations of applied current were measured when the electrode potentials were controlled at constant levels using a potentiostat. The current noise appeared at the potential of +0.6V vs. SSE. The noise was also appeared on a short-circuit current through a pair of half cells that simulated the anodic and cathodic blister parts, respectively (Fig.2). it is estimated the potential noise was

generated by the current noise resulting from a repetition of the breakdown and repassivation<sup>[1]</sup> of the oxide films under the anodic blisters.

The spectrum analysis of the potential noise was attempted. The intensity of the DC component of power spectrum decreased with immersion time. However, the slope of the frequency distribution of the spectrum increased with the time. This shows a possibility that corrosion activity under the coating of a coated iron might be monitored by this method.

## CONCLUSIONS

- 1.The potential noise and the current noise resulted from a repetition of the breakdown and repassivation of the oxide films under the anodic blister.
- 2.Using the spectrum analysis, it was shown that the corrosion activity under the coating of a coated iron might be monitored by this method.

## REFERENCE

- 1.N.Sato, M.Cohen; *J.Electrochem.Soc.*, 111, 512 (1964).

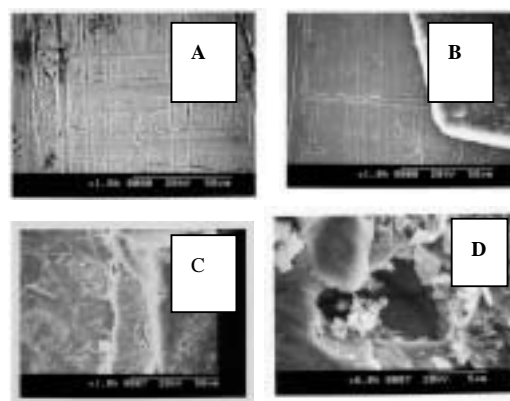


Fig.1 Scanning electron microscopic image of the iron surface.  
(A).The surface after emery polishing of a iron samples.  
(B).The surface of a cathodic blister.  
(C).The surface of an anodic blister.  
(D). Pits observed in an anodic blister.

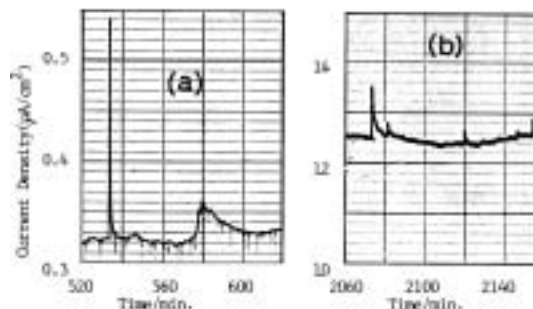


Fig.2 Current noise(a) from polymer-coated iron polarized at an anodic potential of 0.6V and galvanic current noise (b) from the short-circuited electrochemical cell simulated anodic and cathodic blister..