## Electrochemical Noise Study on Galvanic Corrosion of Anodized Aluminum in Chloride Environments

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**Introduction**

Aluminum and its alloys are widely used, because of there high strength - weight ratio and high corrosion resistance. Aluminum and its alloys sometimes were used connecting with another metals for some equipments. A galvanic corrosion occurs in some situations and it is a very severe durability problems of systems.

Aluminum and its alloys are usually used after surface treatments, for example anodizing and painting. It is, however, not clear effect of surface condition on galvanic corrosion of aluminum and its alloys

Recently, electrochemical noise analysis technique have been carried out several corroding environments[1-6)]. The purpose of this study is to examine effect of anodic oxide film structure on galvanic corrosion of pure aluminum by using electrochemical noise analysis technique.

**Experimental**

Specimen : Electro capacitor grade pure aluminum foils, 99.99 mass %, 0.4 mm thick, were cut into 20 x 20 $mm^2$ with a handle. The specimens were degreased in an ethanol ultrasonic bath, electro-polished in a mixture of 70 mass % perchloric acid and acetic acid, volume ratio 1 : 4, at a constant voltage of 28 V, at 286 K. After elector-polished, the specimens were rinsed in doubly distilled water and acetone.

Anodizing : Porous type anodic oxide films were formed by anodizing at 293 K in 0.22 $kmol/m^3$ oxalic acid solution with a constant current density, $i_a$ = 100 $A/m^2$ for different period. Barrier type anodic oxide films were formed by anodizing at 293 K in neutral 0.5 $kmol/m^3$ $H_3BO_4$ / 0.05 $kmol/m^3$ $Na_2B_4O_7$ solution with constant current density, $i_a$ = 10 $A/m^2$ at the initial and then with constant potential for 1800 s. After anodizing, edge of the specimens were sealed with silicone resin and the exposed area was 1 $cm^2$.

Galvanic corrosion test : Specimens were dipped in 0.5 $kmol/m^3$ $H_3BO_4$ / 0.05 $kmol/m^3$ $Na_2B_4O_7$ solution with 0.05 $kmol/m^3$ NaCl, and connected with Pt plate to form galvanic couple, which area is 8 $cm^2$. The galvanic current and specimen potential during test were measured. The records of current and potential were processed by calculating the power spectral density (PSD) by the FFT method. An electrochemical noise impedance was calculated by using current and potential PSD.

Characterization : After the galvanic corrosion tests, specimen surfaces were examined by confocal scanning laser microscope (CSLM).

**Results**

Figure 1 shows change in potential and current with immersion time during galvanic corrosion of Al covered with porous type anodic oxide film, $t_a$ = 300 s, in 0.5$kmol/m^3$ $H_3BO_3$ / 0.05 $kmol/m^3$ $Na_2B_4O_7$ with 0.01 $kmol/m^3$ NaCl. During incubation period ( before 190 ks ), both current and potential do not change as initial value with time, however after that those are suddenly changed with fluctuation, electrochemical noise which is related to localized corrosion. The incubation period of porous type anodic oxide film formed samples are longer than that of barrier type anodic oxide film samples.

Figure 2 shows PSD of potential for Al covered with porous type anodic oxide film at different immersion time, t = 190, 193 and 198 ks . The slope of the spectra is about -1 and shifted to low frequency range with immersion time. The electrochemical noise impedance spectra also decreases with immersion time.

**Reference**

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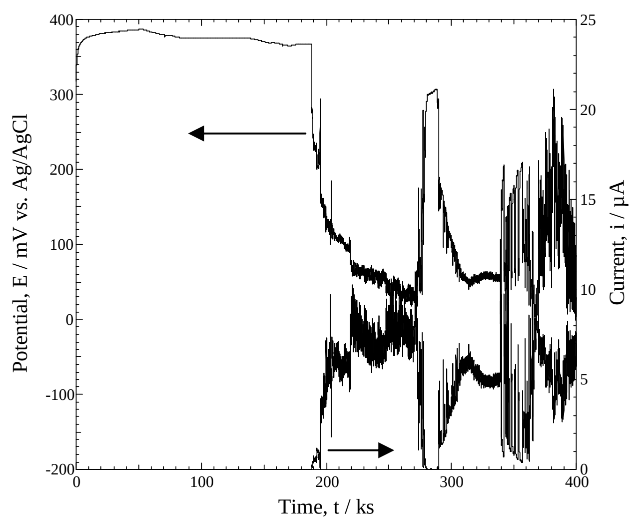


Fig. 1 Change in potential and current with time during galvanic corrosion of Al covered with porous type anodic oxide films, $t_a$ = 300 s, in 0.5$kmol/m^3$ $H_3BO_3$ / 0.05 $kmol/m^3$ $Na_2B_4O_7$ with 0.01 $kmol/m^3$ NaCl.

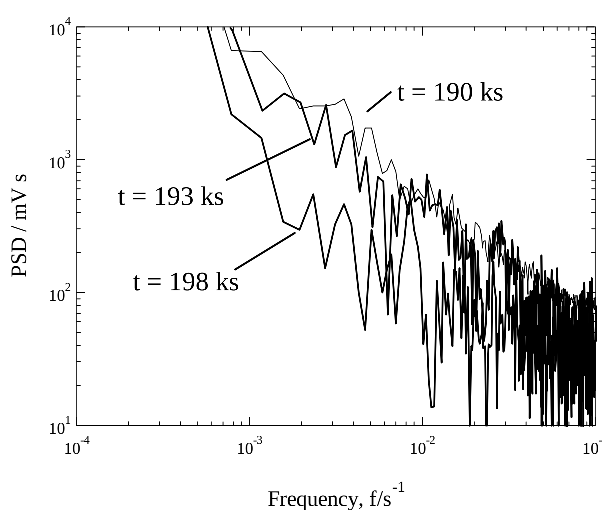


Fig. 2 PSD of potential noise for Al covered with porous type anodic oxide film at different immersion time.