Surface potential distribution observation of surface modified of 304 stainless steel

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1. Introduction

Mechanical surface treatment has been of the most common processes, commonly applied in the metallic material, due to its ability to increase the properties of the substrate without change their chemical composition. The shot peening processes, one of mechanical surface treatment, have received considerable attention due to their versatility in enhancing mechanical properties of metallic material (1,2,3,4). Moreover, other surface properties of the material also suspected affected by this process.

Surface properties are one of the important things in correlation with the corrosion resistances of the metallic materials. The study of the corrosion behavior of the metallic material, like iron and steel, in atmospheric environment is difficult to do due to the conventional electrochemical measurement cannot be applied. Under a thin layer of electrolyte, the mechanism of the corrosion processes is different from corrosion in the solution.

In order to resolve the limitation of conventional electrochemical measurement method in atmospheric environment, a surface potential distribution method that based on the Kelvin probe was applied in this study. The device has a similarity mechanism to the kelvin probe that is non contact method. This method has been used previously (5, 6, 7). In this study the shot peened 304 stainless steel was observed using the surface potential distribution method under a thin layer $MgCl_2$ electrolyte. .

2. Experimental

The 304 stainless steel with a dimension of 20 mm x 30 mm x 1 mm was prepared as specimens. The shot peening process was conducted on the half part of the sample side using SFK-2 Fuji blaster with zirconium ceramic ball as ball peen, which has 210 - 300 µm of diameter and 650-800 Hv of hardness. The half part of the sample was maintained as original condition.

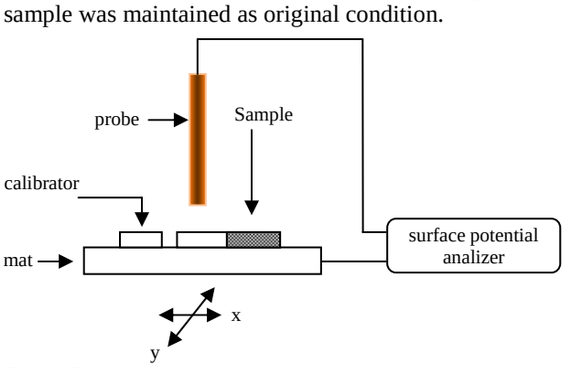

Fig.1. Schematic diagram of surface potential distribution measurement using a surface potential analyzer

Surface potential measurement was conducted to evaluate the corrosion behavior of the sample in the atmospheric environment. This measurement technique is measuring the potential of the surface sample based on the capacitance of the surface sample. This method is convenient for observing the atmospheric corrosion since there is limited in electrolyte on the sample surface. In this study, the measurement was carried on the sample with and without thin layer electrolyte on the surface work. The schematic diagram of the experiment setup is shown in Fig. 1. The platinum (Pt) was employed as calibrator of the potential analyzer prior to measurement. $MgCl_2$ was used as solution droplet that placed on the sample surface due to its deliquescence in atmospheric environment (7, 8). Prior to measurement processes, the sample has been rinsed using 99 % pure ethanol.

3. Result and discussion

Figure 2 shows the surface potential distribution of the untreated and the treated sample without a thin layer droplet on the surface of the sample. The potential of the treated side is shifted more positive than untreated sample. The increment of the potential indicates the treated sample be more noble material and consequently generates the sample to be more corrosion resistant in the atmospheric environment. The surface potential distribution under $MgCl_2$ also appears typical result.

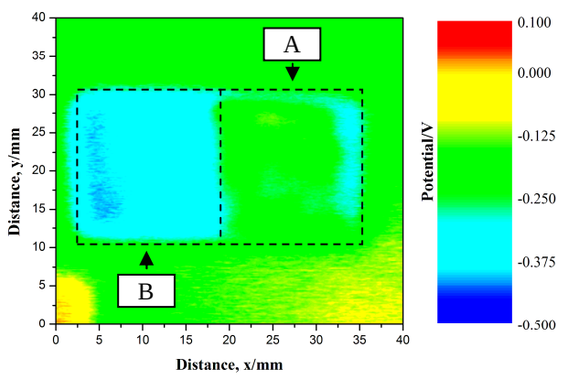

Fig.2. Surface potential distribution of 304 stainless steel with (A) shot peening processes and (B) without shot peening processes.

5. Reference

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