Corrosion Study of Zinc Coated Surface Using In-situ AFM

Kim Yong Hwan,[1] Chung Won Sub,[2] Kim Sang Hun,[3] Seo Geun Ho[4] and Min Byung Seung[5]

[1]Pusan National University
Dept. metallurgical engineering
Jang Jun Dong, Kum Jeong Gu
Pusan 609-735
Republic of Korea

[2]Pusan National University
Dept. metallurgical engineering
Jang Jun Dong, Kum Jeong Gu
Pusan 609-735
Republic of Korea

[3]Kwangyang Rolling Products Research Group
POSCO
699,Kum Ho Dong
Kwang Yang 545-090
Republic of Korea

[4]Pusan National University
Dept. metallurgical engineering
Jang Jun Dong, Kum Jeong Gu
Pusan 609-735
Republic of Korea

[5]Pusan National University
Dept. metallurgical engineering
Jang Jun Dong, Kum Jeong Gu
Pusan 609-735
Republic of Korea

1. Introduction

Hot-dip galvanized steel sheet has been used to corrosion prevent material in industry. And its corrosion test has been carried out much in macro-scale. But in micro-scale, Corrosion behavior of zinc coated surface is complex. Therefore its mechanism has not been completely understood. We tried to approach this corrosion behavior in micro-scale by using in-situ AFM. Especially focused on the spangle which characteristic appearance, formed by solidification process. This spangle is divided into three parts-shinny,feathery and dull-which have different structure, morphology and surface composition. The corrosion behavior of each parts were investigated by in-situ AFM study. Also other electrochemical experiments were performed for this study.

2. Experimental

The bath composition for specimen was Zn-0.18spangle growth was promoted by air cooling process. Electrochemical corrosion behaviors of the each spangle parts were tested by Anodic polarization and A.C Impedance test. To investigate the effects of crystal orientation and alloy elements,Al and Sb, XRD and EPMA were used. By using in-situ AFM, each spangle parts were observed in pure water. And in 0.01M NaOH solution, corrosion behavior were investigated according to potential.

3. Results and conclusion

Electrochemical corrosion test results showed that dull part of spangle has lower corrosion resistance than feathery or shinny part. In-situ AFM observation shows below; Pure zinc surface was dissolved and thin oxide film was formed. Then small pits appeared at oxide film. The number and size of pits had increased until oxide film was broke down. After that new oxide particles appeared and grew on the surface. The dissolution of pure zinc looks like a leveling effect. And it is assumed that Al,alloy element,accelerate this behavior. Therefore dull spangle part,which has high Al density,is considered that it is prior corrosion spangle part and has lower corrosion resistance. We concluded that not only surface composition but morphology, results of solidification, is very important factor in the aspect of the corrosive adsorption.

4. Reference

[1] S.Chang and J.C.Shin, Corrosion Science, Vol.36, No.8, pp.1425-1436,1994 [2] Su-Il Pyun, Joon-Sung Bae, Sung-Yeol Park, Jong-Sang Kim and Zin-Hyoung Lee, Vol.36, No.5, pp.827-835, 1994 [3] Xiaoge Gregory Zhang: corrosion and electrochemistry of zinc, Plenum Press, New York and London [4] K. Uchida, H. Ishida, K. Koshiishi, K. Katayama, T. Deguchi and F.Kumon, Trans. ISIJ, Vol.24, 1984 [5] J.Struzenberger and J. Faderl, Metallurgical and Materials Transactions A, Vol.29, pp.631-646, 1998 [6] P.R.Sere, J.D.Culcasi, C.I.Elsner and A.R.Di Sarli, Surface and Coatings Technology, Vol.122, pp.143-149, 1999 [7] Digby D.Macdonald, Khaled M. Ismail and Elzbieta Sikora, J. Electrochem. Soc., Vol.145, No.9, 1998