Effect of Cr on the reduction behavior of corrosion product formed on low alloy steels in flowing thin electrolyte layer

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Abstract The reduction behavior of rust layer formed on carbon steel and on Cr-containing steels has been investigated in flowing thin electrolyte layer with 3.5% NaCl solution, via potentiodynamic polarization curve, EPMA, Raman spectroscopy, XRD, and XPS. The cathodic potentiodynamic polarization curves of carbon steel and Cr-containing steels were carried out in flowing thin electrolyte layer with vacuum environment, for eliminating the reduction reaction of oxygen. Results show that the cathodic reaction of Cr-containing steels was inhibited by concentration of Cr in the inner rust layer, and the reduction of rust layer formed on Cr-containing steels was also inhibited. The constituent of rust layer formed on carbon steel was the same with that of Cr-containing steels. However, the amount of Fe_3O_4 in the rust layer formed on carbon steel was higher than those formed on Cr-containing steels after cathodic potentiodynamic parization curves. It indicates that the reduction of Fe^{3+} was suppressed for Cr-containing steels. Cr exited in the form of Cr^{3+} in the corrosion product, participating in the transformation of corrosion product.

Keywords *Chromium,cathodic reaction, reduction behavior, low alloy steel;*

Reference

[1] E.Sarver, M.Edwards, Effects of flow brass location, tube materials and temperature on corrosion of brass plumbing devices, Corros.Sci. 53(2011)1813-1824.

[2] J.A.Wharton, R.J.K.Wood, Influence of flow condition on the corrosion of AISI 304L stainless steel, Wear 256(2004)525-536.

[3] T.Misawa, T.Kyuno, W.Suetaka, S.Shimodaira, The Mechanism of Atmospheric Rusting and the Effect of Cu and P on the Rust Formation of Low Alloy Steels[J]. Corrosion Science, 1971, 11(1): 35-38.

[4] T.Misawa, K.Asami, K.Hashimoto, S.Shimodaira. The Mechanism of Atmospheric Rusting and the Protective Amorphous Rust on Low Alloy Steel[J]. Corrosion Science, 1974, 14(4): 279-289.

[5] H.Okada, Y.hosoi, H.Naito, Electrochemical Reduction of Thick Rust Layers Formed on Steel Surface[J]. Corrosion, 1970, 26(10): 429-430.

[6] M.Stratmann, K.Bohnenkamp, H.J.Engell, An Electrochemical Study of Phase-transitions in Rust Layers. Corrosion Science, 1983, 23(9): 969-985.

[7] U.R.Evans, C.A.J.Taylor, Mechanism of Atmospheric Rustiong. Corrosion Science, 1972, 12(3): 227-246.

[8] M.Stratmann, K.Hoffmann, In situ Möβbauer Spectroscopic Study of Reactions within Rust Layers, Corrosion Science,1989, 29(11/12): 1329-1352.

[9] K.Inouye, K.Ichimura, K.Kaneko, T.Ishikawa, The effect of copper(II) on the formation of γ-FeOOH[J]. Corrosion Science, 1976, 16(8): 507-517.

[10] M.Stratmann, K.Bohnenkamp, T.Ramchandran, The Influence of Copper upon the Atmospheric Corrosion of Iron[J]. Corrosion Science, 1987, 27(9): 905-926.