Effects of Nitrogen on the Metastable Pitting and Repassivation Behavior of Austenitic Stainless Steels in Chloride Solutions

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It is well known that small amount of nitrogen improve significantly both the resistance to localized corrosion and mechanical properties of austenitic and duplex stainless steels. In this work, the effects of nitrogen on the metastable pitting and repassivation behavior of Fe-19Cr-10Ni alloys in chloride solution were examined using electrochemical noise analysis (ENA) and scratching electrode techniques [1]. Especially, the repassivation rate were evaluated in terms of a new parameter derived from the high field ion conduction model of film growth.

Results of ENA showed that the addition (0.1 wt. %) of nitrogen to Fe-19Cr-10Ni alloy increased significantly the resistance to metastable pitting, which was confirmed by the appreciable decrease in the number of metastable pitting event simultaneously with the reduction in the intensity of the power spectrum density (PSD) at low frequency region. These beneficial effects of nitrogen were more prominent with increasing chloride concentration, solution temperature, and applied potential. Further, repassivation occurred much faster in the nitrogen added alloy than did in the alloy without nitrogen, suggesting that nitrogen may enhance the resistance to stress corrosion of stainless steels. These beneficial influences of nitrogen on the metastable pitting and repassivation behavior of austenitic stainless steels were discussed and rationalized based on the surface enrichment theory[3] and the ammonium production theory[4].

References

1. E.A. Cho, C.S. Kim, J.S. Kim, and H.S. Kwon, Electrochim. Acta, 45 (2000): *p. 1933*

2. H.S. Kwon, E.A. Cho, and K.A. Yeom, Corrosion, 56 (2000): *p.32*

3. R. Bandy and D. van Rooyen, Corrosion, 41 (1985): *p. 228*.

4. K. Osozawa and N. Okato, *"Effect of Alloying Elements, Especially Nitrogen, on the Initiation of Pitting in Stainless Steel, Passivity, and its Breakdown on Iron and Iron-Base Alloys"*, eds. R. Staehle and H. Okada (Houston, TX: NACE), *p.135* (1976).