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Evaluation of Hydrogen Absorption Behavior of High Corrosion-Resisted Alloys in Salt Water

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Summary

The hydrogen absorption behavior of high corrosion-resisted alloys in salt water has been systematically evaluated on the basis of electrochemical behavior and hydrogen thermal desorption analysis. Ni-Ti superelastic alloy, which has surface films of TiO_2 similar to those of Ti and its alloys, is immersed in neutral 0.9 mass% and 3.5% NaCl aqueous solutions under constant applied potential for 2 h. The critical potential for hydrogen absorption is approximately -0.9 V_{SCE} and independent of the concentration of NaCl. This result clearly indicates that for Ni-Ti superelastic alloy, compared with Ti and its alloys, the critical potential for hydrogen absorption is located in a more noble direction. Under applied potential below -0.9 V_{SCE}, the amount of absorbed hydrogen increases with decreasing applied potential. Under applied potential of -1.2 V_{SCE}, the amount of absorbed hydrogen is 200 to 400 mass ppm. For the same experimental conditions, the amount of absorbed hydrogen of Ni-Ti superelastic alloy is larger than those of Ti and its alloys. In contrast, the amount of absorbed hydrogen of Ni-Ti superelastic alloy immersed under applied potential of -1.5 V_{SCE} in 3.5% NaCl solution is larger from 100 to 300 mass ppm than that in 0.9% NaCl solution. The increase is consistent with the increase in amount of evolved hydrogen predicted from cathodic polarization curves. The hydrogen thermal desorption behavior of Ni-Ti superelastic alloy often depends on hydrogen absorbing conditions such as type of solution and pH, but it is only slightly changed by the concentration of NaCl. Thus, it appears that the effects of the concentration of NaCl on hydrogen states in the alloy are small. The present study indicates that Ni-Ti superelastic alloy, compared with Ti and its alloys, readily absorbs substantial amounts of hydrogen; hence, susceptibility to hydrogen embrittlement is high in salt water.