Passivity of Extremely Corrosion Resistive Iron Alloys

High Corrosion Resistance of Chromium-Bearing Amorphous Iron Alloys in Neutral and Acidic Solutions Containing Chloride

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The corrosion resistance of amorphous iron alloys, whose practical application is expected because of their outstanding mechanical properties, has been studied by total immersion tests and electrochemical methods in acidic and neutral solutions containing chloride. In a 1 N NaCl solution at 30 C, 0.01–1 N HCl solutions at 30 C and in 6% $FeCl_3$ solutions at 40 and 60 C, the amorphous Fe-Cr-P-C and Fe-Cr-Ni-P-C alloys did not suffer pitting corrosion, and no weight losses were detected on the alloys containing 8 At% or more chromium using a microbalance after exposure for 168 hours. The polarization curves of the amorphous alloys did not exhibit the critical potential for pitting, and no anodic current densities higher than 10^{-7} A/cm^2 were observed over the potential range 0 to 0.5 V(SCE) in 1N NaCl and 0 to 0.9 V (SCE) in 1 M H_2SO_4 by potentiostatic anodic polarization of the alloys containing 8 At% or more chromium. The high corrosion resistance of the amorphous iron alloys results partly from the presence of chromium and large amounts of phosphorus and partly from a homogeneous single phase amorphous structure.

Characteristics of Passivity of Extremely Corrosion-Resistant Amorphous Iron Alloys

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The amorphous Fe-Cr-P-C alloy was compared with the crystallized alloy having the same composition in potenitodynamic polarization curves and with an 18Cr-8Ni stainless steel in current decay after abrading the specimens under anodic polarization. Through these results along with the previous ESCA study, the extremely high corrosion-resistance of the amorphous iron alloys containing 8 at.% or more chromium has been interpreted in terms of the rapid formation of thick, uniform, highly corrosion-resistant passive film due to the characteristics of the amorphous alloys.

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"Passivity and Its Breakdown on Iron and Iron Base Alloys", 1975, Honolulu, p. 34, Ed. by R.W. Staehle and H. Okada, National Association of Corrosion Engineers, Houston, Texas, (1976).

This paper reviews studies on corrosion resistance of chromium bearing amorphous iron alloys and high purity-high chromium ferritic steels containing molybdenum. High corrosion resistance of these alloys have been interpreted in terms of the compositions and functions of the passive films formed on these alloys.