Interpretation of EIS Data on the Aluminum Alloy in Binary Salt Hydrate System

Ji Haotian[1], Wang Jing[1], Yong Xingyue[1]

[1] *Beijing University of Chemical Technology, Beijing, 100029, P. R. China*

Abstract In this study, the corrosion behavior of 6063 aluminum alloy in Na_2SO_4-Na_2HPO_4-H_2O system was studied by EIS measurements. As shown in Fig.1, with the developing depth of corrosion pits, the impedance level had shown a sharp decrease with time. A middle frequency inductive loop was found in the Nyquist plot after 72h immersion, while in the initial (12h) and final (168h) stage of the immersion, the Nyquist plot showed two capacitive loops with absence of inductive behavior. Similar inductive loops had been reported on the EIS data in alkaline media (KOH). In order to explain the occurrence of inductive behavior in molten salt hydrate systems, six type of different media with pH value equals 3.5, 7 and 9 were prepared, Na_2HPO_4 and Na_2SO_4 were added separately to study influence from different type of anions. Nyquist plots in Fig.2 gave a clear conclusion that the Na_2SO_4 media were more sensitive to pH changes, a low frequency inductive loop was found in the acid media showing early stage of pitting corrosion. Inductive loops were found in Na_2HPO_4 systems under three different pH value media. Considering the hydrolysis reaction of HPO_4^{2-}, the interim inductive behavior of impedance data in Na_2SO_4-Na_2HPO_4-H_2O system can be explained by the hydrolysis reaction of HPO_4^{2-}, while the existence of SO_4^{2-}resulted in a competitive reaction on the sample surface.

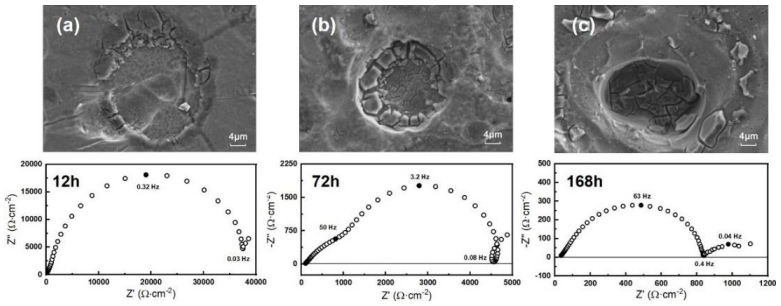

Fig.1 Morphology of the corroded area and the corresponding Nyquist plot after (a) 12h (b) 72h and (c)168h immersion

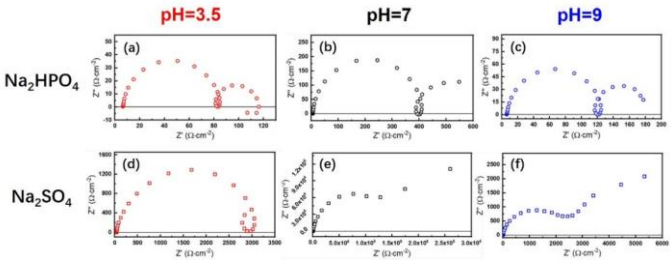

Fig.2 Nyquist plot of Al-alloy samples in saturate Na_2HPO_4 and Na_2SO_4 solutions with different pH values