Synergistic Effect of Ni and Co Alloying on Corrosion Behavior of Fe(Ni,Co)P₁₃C₇ Metallic Glasses in 1M NaCl Solution

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This study focuses on the transition metal and metalloid containing advanced amorphous alloys possessing excellent corrosion resistance in 1 M NaCl solution. 4 different alloy compositions, including base composition and with Ni and/or Co additions, Fe_{80-x-y}Ni_xCo_yP₁₃C₇, are investigated for their electrical characteristics by electrochemical impedance spectroscopy (EIS) and corrosion behavior by linear sweep voltammetry. A prolonged characteristic frequency in the Bode phase due to double peak formation and the steepest increase in the near-DC region is observed for the Fe₆₀Ni₁₀Co₁₀P₁₃C₇. From the fitting of the EIS data with R(QR(QR)) circuit model, the lowest capacitance ($3.87 \times 10^{-5} \text{ S s cm}^{-2}$) and largest resistance ($3390 \text{ } \Omega \text{ cm}^{-2}$) are obtained for the same alloy, confirming the highest passivity. Low anodic Tafel slope (23 mV dec^{-1}) and corrosion current density ($5 \text{ } \mu\text{A cm}^{-2}$) yield a minimal annual corrosion rate of 0.08 mm yr^{-1} . Hence, this multi-component metallic glass alloy is foreseen to replace other relevant metals due to its enhanced corrosion resistance in a saline environment and cost-effective material and production costs.

Keywords: metallic glass, transition elements, electrochemical impedance spectroscopy, polarization curve, corrosion properties

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