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Passive film's resistivity distribution of crystalline Fe-based pseudo high entropy alloys

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Keyword: This study thoroughly examines passive film formation on two newly developed pseudo-high entropy alloys - the Nb-containing alloy (Fe-Cr-Mo-Nb-B) and the Ni-containing alloy (Fe-Cr-Mo-Ni-B). A comprehensive analysis combines potentiodynamic polarization curves, EIS, and XPS techniques. The samples used in the study encompassed both as-spun (amorphous) and annealed (crystallized) ribbons. The alloy containing Nb maintained excellent resistance against corrosion at temperatures up to 720°C, while the alloy containing Ni showed no significant changes in its corrosion properties up to 690°C. However, ribbons that underwent heat treatment at temperatures exceeding 800°C exhibited generalized corrosion. The EIS data of the samples that displayed a passivation plateau were analyzed using Measurement Model software to validate the data and estimate the system's global capacitance, which helped evaluate the thickness of the passive film. Since we focused on the oxide layer, we partially fitted the diagrams to extract information such as resistivity in the metal/oxide interface and the oxide/electrolyte interface. The electrical properties of the oxide layer were analyzed using a power law model. The resistive values observed were consistent with those of a passive protective layer, decreasing with increasing temperature. XPS analysis revealed that the elements in the alloy formed oxide on the surface, with Nb oxides contributing significantly to the formation of the passive film. This made the surface protective, especially when compared to the Ni-containing alloy. The study provides insights into how crystallization affects the corrosion properties of the two alloys. This is the first time such a study has been conducted on PHE, and it offers a detailed understanding of the mechanisms at the interface and the formation of the passive film.