

The corrosion behavior of FeNi-based anode driven by microzone acidification at the electrode/electrolyte interface

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Abstract The anodic microzone acidification and cathodic microzone alkalization during water electrolysis can lead to electrode surface corrosion and clogging. The degree of microzone acidification and its effect on the transition metal-based anodes have not been systematically studied. Here, the relationship between electrolysis conditions and the degree of microzone acidification and the corrosion behavior of FeNi-based anodes were explored under simulated alkaline seawater (1 M KOH + 0.5 M NaCl) by varying the applied current density and bulk pH.

It was found that the electrode stability was sensitive to electrolysis conditions, failing at 20 mA cm⁻² in 0.1 M KOH + 0.5 M NaCl but over 500 mA cm⁻² in 0.5 M KOH + 0.5 M NaCl. The electrode dissolved, and some precipitates immediately formed at the region very close to the electrode surface during the electrolysis. This can be ascribed to the pH difference between the electrode/electrolyte interface and the bulk electrolyte under anodic polarization. In other words, the microzone acidification accelerates the corrosion of the electrode by Cl⁻, thus affecting the electrode stability. The operational performances of the electrode under different electrolysis conditions were classified to further analyze the degradation behavior, which resulted in three regions corresponding to the stable oxygen evolution, violent dissolution–precipitation, and complete passivation processes, respectively. Thereby increasing the bulk pH could alleviate the microzone acidification and improve the stability of the anode at high current densities.

Our study semi-quantitatively defines the relationship among electrolysis conditions, the degree of microzone acidification, and the corrosion behavior of the FeNi-based electrode, which provides new insights into understanding the degradation mechanism of NiFe-based catalysts.

Keywords Microzone Acidification; Oxygen Evolution Reaction; Anodic corrosion; Electrolyte Engineering