Influence of Cerium and Tungsten Addition on the Passive Behaviour of 444-type Ferritic Stainless Steels

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The surface passivity properties of conventional 444-type ferritic stainless steel (FSS), Ce-containing 444-type FSS and W-Ce-containing 444-type FSS were studied in a 1.0 mol/L H₂SO₄+0.5 mol/L NaCl solution by employing electrochemical impedance spectroscopy (EIS) analysis, the potentiodynamic polarization test and capacitance measurement. The potentiodynamic polarization curves revealed that the Ce and/or W addition did not affect the pitting potential E_p and the corrosion potential E_{corr} , whereas the corrosion current density i_{corr} and the passive current density i_p were decreased significantly. The morphological observation of the specimens after polarization suggested that alloying with Ce and W decreased the number of pitting sites and inhibited the active dissolution of pits. The Mott-Schottky analysis revealed that all the oxide layers formed on FSS behaved as n-type semiconductors at the potential range of 0.3–0.8 V_{SCE} and that the donor concentration N_D in the passive film increased with Ce and W alloying. In addition, the diffusivity values of the donors in FSS passive films were calculated based on the combination of capacitance measurements and PDM theory. The EIS analysis showed that the Ce-W-containing stainless steel presented lower polarization resistance values.

Keywords: Ferritic stainless steel; Tungsten; Cerium; Passive film; Diffusivity.

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