Passive Properties of Cr₁₂Ni₃Co₁₂Mo₄W Ultra-High-Strength Martensitic Stainless Steel

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The passive properties of the Cr₁₂Ni₃Co₁₂Mo₄W ultra-high-strength martensitic stainless steel were investigated by surface analysis techniques and electrochemical measurements. The potentiodynamic polarization curves exhibited a wide passivity region, which indicated that the ultra-high-strength martensitic stainless steel exhibited excellent electrochemical characteristics in 0.1 M Na₂SO₄ solution (pH = 3). The thickness of the passive films increased from 0.7 nm to 5.2 nm with the increase of film formation potential. The passive films formed at different potentials exhibited n- and p-type semiconductor behaviors. The passive films formed at more positive potentials were more stable, with lower oxygen vacancy concentrations than those formed at lower potentials. The films formed at anodic potentials primarily comprised FeO, Fe₃O₄, Fe₂O₃, Cr₂O₃, Cr(OH)₃, NiO and MoO₃. The passive films formed at anodic potentials were predominantly composed of Fe oxides, whereas those formed at cathodic potentials were primarily composed of oxides and hydroxides of Cr. The contribution of alloy element Ni to the passivity performance of the steel was larger than that of Mo. During the pitting corrosion, the passive films remarkably increased the pitting potential.

Keywords: potential, passive film, ultra-high-strength martensitic stainless steel, electronic properties, XPS

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