

Effect of microstructure on stress corrosion behavior of ultra-high strength stainless steel 10Cr13Co13Mo5Ni3W1VE (S280)

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Abstract: Ultra-high strength stainless steel is extensively utilized in aircraft girder, landing gear and other aspects, its service behavior is crucial for the sustainable development and industrialization of aerospace technology and other fields. This paper investigates the evolution of microstructure and surface passive film of S280 steel under the aging conditions of 200°C, 400°C and 500°C by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and energy dispersive spectroscopy (EDS). The corrosion resistance of S280 was assessed using electrochemical testing methods. The stress corrosion behavior of S280 steel at different aging temperatures was analyzed by finite element simulation. The results show that the corrosion resistance decreases with aging temperature increasing. According to the metallography morphology, pitting pits exist both inside the martensitic matrix and at the grain boundaries. The martensitic lath of the sample aged at 500°C has long and spherical precipitates, with Mo element segregation and Cr poor zone in the precipitates, which results in pitting corrosion and decrease the corrosion resistance of the sample aged at 500°C. The main crack source of the sample under stress corrosion is pitting pit, and the expansion form is radiative. The main reason for the failure of materials in corrosive environment is the stress concentration point caused by surface erosion failure, forming crack source and accelerating crack propagation. The finite element analysis indicates that S280 steel has the highest stress corrosion sensitivity when aging at 500°C.

Keywords S280 ultra-high strength stainless steel; microstructure; stress corrosion; simulation calculation

Reference

[1] Lin X, Xie P, Yi W, et al. Method for determining silicon content in D406A steel involves weighing D406A steel sample in 100 mL steel measuring bottle, adding mixed acid, preparing series of silicon standard solutions, measuring sample solution, and determining concentration of measured silicon element[P]. CN: 116593667-A, 2023-03-14