Effect of Cathodic Potentials on the Hydrogen Embrittlement Susceptibility of 10Ni5CrMo Steel

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The effects of the cathodic polarization potential on the hydrogen embrittlement susceptibility of 10Ni5CrMo steel in seawater were studied using a slow strain rate tensile test (SSRT) combined with observation of the fracture morphology and electrochemical measurements, as well as the hydrogen permeation test. The results showed that the rate controlling step of the cathode reaction changed from the oxygen depolarization reaction to the hydrogen depolarization reaction with the increase in the cathodic polarization level. With the negative shift in the polarization potential, the sample's reduction of area (R/A) and elongation decreased, and the fracture surfaces of the specimens displayed a transition from ductile microvoid coalescence to cleavage; however, the strength of the 10Ni5CrMo steel did not change significantly. The hydrogen embrittlement coefficient reached a threshold of 25%, while the polarization potential was approximately -992 mv (vs. SCE). In conclusion, the limiting cathodic protection potential of 10Ni5CrMo steel in a seawater environment was -992 mv.

Keywords: 10Ni5CrMo steel, cathodic polarization, hydrogen embrittlement, high strength steel, SSRT

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