Study on microstructure evolution and stress corrosion behavior of thermal aging 316NG weld metal

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Abstract 316NG stainless steel welds containing a small amount of δ-ferrite are susceptible to thermal aging effect after long-term service at high temperature of nuclear reactor operation. 316NG stainless steel welds are subject to the coupling effect of stress and environment, leading to the risk of stress corrosion cracking and threatening the long-term operation safety and stability of nuclear reactor. The microstructure of 316NG welds thermal aged at 400℃ for 6000h, 18000h, 30000h was characterized by TEM, and the slow strain rate tensile test of thermal aging 316NG welds under simulated PWR primary water environment was carried out. The experimental results showed that the ferrite phases of thermal aging 316NG welds had obvious spinodal decomposition, and the G phase rich in Ni, Mn and Si precipitated in the ferrite phase. The spinodal decomposition degree increased with the thermal aging time, but it decreased when 316NG welds aged for more than 18000h. The fracture of as-received and thermal aging 316NG welds SSRT specimens was mixed fracture consisting of dimples and quasi-cleavage. The ratio of brittle zone area to the fracture area of as-received and thermal aging specimens were estimated separately, showing that thermal aging slightly reduced the stress corrosion susceptibility of 316NG welds.

Keywords thermal aging; 316NG weld; Stress corrosion behavior