Study of Nano-Microstructures on SCC in 316L Stainless Steel

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Recent studies on stress corrosion cracking (SCC) behaviors of austenitic stainless steels in boiling water reactors (BWR) show that SCC can occur on cold-worked and welded sus316L type stainless steel. It is very important to understand the cause of SCC initiation based on the relationship between microstructure and crack initiation.

In this study, microstructural observations and chemical composition Creviced-Bent-Beam (CBB) specimens tested in BWR normal water chemistry (NWC) simulated hot water using a transmission electron microscopy with EDS.

It was found that microstructure of the top surface worked by grinding bands including deformation twins in the deeper region. In the CBB tested specimens, both TGSCC and IGSCC initiation were observed. Transition from the TGSCC to IGSCC was observed in deeper region. TEM observation analyses were carried out along SCC initiated in surface around Creviced-Bent-Beam that oxide films were preferentially formed along deformation twins before crack initiation in TGSCC. Namely, most of formation of oxide films and subsequent cracks were initiated along twin plane of <111> direction rather than grain boundaries.

It was also identified from microstructural contrast and EDS compositional analysis that the oxide layer consists of double oxide layers, namely, the outer layer was composed of grown crystalline of magnetite Fe_3O_4 and the inner layer of oxide. Furthermore it was observed that at the crack tip the Cr-rich oxide was initially formed and with growth of the oxide films. In these processes the oxide layers were open due to expansion of the oxide and or crack formation.

Recent studies on stress corrosion cracking (SCC) behaviors of austenitic stainless steels in Boiled water reactor show that SCC can occur on cold-worked SUS316 stainless steel.