

## Insights into dissolved oxygen dependent crack initiation and propagation mechanism of 316LN stainless steel fatigue tested in high-temperature pressurized water

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**Abstract** 316LN stainless steel (SS) has been extensively used as the primary pipe in pressurized water reactors. Corrosion fatigue (CF) is an important potential failure mode for primary pipes due to fatigue cycle stress [1]. In the primary circuit system, the replenishment of cooling water and the processes of shutdown and maintenance may cause an increase in DO, which affects the CF property of materials. However, the effect of DO on the fatigue life of austenitic SS in high-temperature pressurized water remains controversial. It is necessary to clarify the role of DO on fatigue crack initiation and propagation. The corrosion fatigue behavior of 316LN SS hollow specimen was investigated in high-temperature pressurized water at different dissolved oxygen (DO) concentrations (<5-200 ppb). It was found that the fatigue life of 316LN SS significantly increased with increasing DO concentration from <5 to 20 ppb, while the effect of DO on fatigue lives apparently saturated at above 20 ppb (20-200 ppb). DO plays a significant role in microstructurally small cracks rather than mechanically small cracks. The oxidation characteristic of slip bands affects the crack initiation process. The high DO accelerated the repair of oxide film and prolonged the fatigue crack initiation time by inhibiting the growth of microstructurally small cracks, which increased the fatigue life of 316LN SS.

**Keywords** Stainless steel; Dissolved oxygen; Corrosion fatigue

### Reference

[1] Y. Xiong, Y. Watanabe, Y. Shibayama, N. Mary, Effects of 100 ppb dissolved oxygen on low-cycle fatigue behaviors of 316LN austenitic stainless steel in borated and lithiated high temperature water and mechanism behind these effects, Corros. Sci., 168 (2020) 108567.