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The potential of spinodal ferrite decomposition for increasing the very high cycle fatigue strength of duplex stainless steel

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Abstract

Duplex stainless steels (DSS) have become candidate materials for structural applications, where conventional austenitic stainless steels fail due to very high cycle fatigue (VHCF) in combination with corrosive attack. It seems that DSS exhibit a fatigue limit, which can be attributed to the two-phase austenitic-ferritic microstructure. Ultrasonic VHCF testing revealed that the phase boundaries are efficient obstacles for the transmission of slip bands and microstructural fatigue cracks up to 10^9 cycles and even beyond. The barrier strength is determined by the misorientation relationship between neighbouring grains but also by the strength of the individual phases. By thermal treatment at 475°C, spinodal decomposition of the ferrite phase results in the formation of Cr-rich α´ precipitates. While during static loading these precipitates give rise to a loss in ductility (475°C embrittlement), it was shown that the