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**Very high cycle fatigue of cold rolled stainless steels, crack initiation and formation of the fine granular area**

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**Abstract**

Fatigue test data of cold rolled strip steels, a duplex stainless steel and a martensitic stainless steel, was generated in the Very High Cycle Fatigue (VHCF) regime. Testing was conducted using ultrasonic fatigue test instrument operating at 20 kHz in the fully reversed tension-compression load condition. In both tested grades, fatigue failures initiated from surface defects left by cold rolling or from surface located inclusions. The Fine Granular Area (FGA) feature was observed on the fracture surface and analysed using Scanning Electron Microscope (SEM). Transverse cross-sections from fracture surface were extracted using Focussed Ion Beam (FIB) and analysed using Transmission Electron Microscope (TEM). The thickness of the fine grained layer in the extracted cross-section of the duplex stainless steel was 100-350 nm while for the martensitic stainless steel it was only 10-20 nm. The fine grained layers seemed to be composed of nano-sized grains with different crystallographic orientations. The secondary crack was found to grow through the middle of the layer instead of at the FGA-bulk material interface. The grain refinement mechanisms in the FGA were discussed in perspective of the

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