

## LOAD PARTITIONING IN A DUPLEX STAINLESS STEEL WITH SURFACE STRENGTH GRADIENT AND RESIDUAL STRESSES

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Many manufacturing processes impose, intentionally or unintentionally, changes to the surface layer of engineering components, such that a strength gradient is induced and residual stresses are created. It is well known that such changes play an important role for the mechanical behavior of the components. In particular, it is well established that fatigue properties can be enhanced by a hardened surface layer with compressive residual stresses but reduced by a surface layer in tension. However, due to experimental difficulties, little work has been carried out to study the actual stress distribution across the load-carrying cross-section under external loading and to analyze the influence of load type, strength gradient and residual stresses on the induced load partitioning. Component failure is closely related to the local stress distribution and therefore such investigations on inhomogeneous load-sharing will not only help understand the true mechanisms for the development of material damage under the action of mechanical load but also provide valuable input for simulation and operation of engineering structures.

The purpose of the current work is to study the load-partitioning for superduplex stainless steel SAF 2507 with surface strength gradient and residual stresses by means of in-situ synchrotron energy dispersive diffraction. The steel used in the study was a 6.4 mm thick plate processed by hot rolling, having a microstructure of austenite and ferrite. The plate was solution treated, followed by surface mechanical treatment that introduced strain hardening and compressive stresses to a surface layer of about 0.2 mm. The in-situ experiment was carried out for two loading-unloading cycles with a larger peak plastic strain for the second cycle. Diffraction experiments in reflection geometry were employed to obtain stress information in the austenite and ferrite for the very surface layer (about 0.03 mm). Additional measurements in transmission mode were performed on the austenite and ferrite at 0.75 mm depth, the behaviour of which can be considered representative for the bulk of the specimen. The results reveal different behaviors for the surface layer and the bulk, which has generated macroscopic load transfer between the two regions during loading. In addition, hkl-plane dependent microstresses that play an important role for the load-sharing at microstructural level are observed in both regions. In the paper, the macroscopic load-sharing and interactions between the applied load and different structural features will be discussed.