Walther, Frank:

Einfluss der ortsabhängigen Mikrostruktur auf das Ermüdungsverhalten hochbeanspruchter Radstähle

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Abstract

In the present work, strain, temperature, voltage and GMR-measurements were performed on railway wheel and tire steels in technical relevant, UIC-conformable heat treatment conditions to describe the influence of the local microstructure on the cyclic deformation behavior at ambient and elevated temperatures in the range $200^\circ\text{C} \leq T \leq 500^\circ\text{C}$. The cyclic deformation behavior was determined by single and multiple step tests under stress and total strain control, a frequency of 5 Hz and triangular load-time functions. The influence of mean stresses and mean strains on cyclic creep- and mean stress relaxation processes was investigated. For the evaluation of variable amplitudes and service loading a new testing procedure was used, which includes single step sequences at a load level below the endurance limit. Within the single step sequences characteristic values from the stress strain hysteresis measurements can be obtained to create representative cyclic deformation curves. Temperature and voltage measurements can be done continuously during variable amplitude loading. The microstructural characterization of specimens in unloaded, defined fatigued and service loaded conditions was done by light, scanning and transmission electron microscopy. Transmission electron microscopy of selected fatigue states and X-ray diffraction investigations of the dislocation density allow the evaluation of the microstructural changes. Digital image processing and scanning electron microscopic surface analyses are used to evaluate the deformation characteristics and failure mechanisms under cyclic loading.

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