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EFFECT OF SHORT-TERM AGING ON THE LOW CYCLE FATIGUE BEHAVIOR OF ADVANCED 10% Cr STEEL

Mishnev R., Dudova N., Kaibyshev R.
Belgorod State University, Belgorod

High-chromium martensitic steels are used as creep-resistant materials capable of operating in the high-temperature boiler tracts, steam pipelines and turbines of ultra-supercritical fossil power plants at metal temperatures approaching up to 650°C. A new generated 10% Cr heat-resistant martensitic steel (10%Cr-2%W-0.7%Mo-3%Co-NbV) with high B (0.008%) and low N (0.003%) contents demonstrates a unique high creep resistance. The high creep strength of this type of steels is attributed to the tempered martensite lath structure (TMLS) consisting of a hierarchical sequence of structural elements with high dislocation density. The stability of TMLS is provided by the nanoscale M(C,N)-type carbonitrides distributed within the ferritic matrix and $M_{23}C_6$ carbides that are located on the all type boundaries.

Low cycle fatigue (LCF) which is caused by cyclic thermal stresses from start-up/shut-down regimes of steam turbines, also induces transformation of the TMLS to the subgrain structure which deteriorates the creep strength. It has been shown recently how changing the LCF test regimes affects the cyclic behavior and fatigue life of the 10% Cr steel. However, effect of aging on the cyclic behavior of the steel has not been yet established. It's known that the Laves phase particles precipitate on boundaries during long-term aging that can affect the fatigue life.

In this work, the effect of short-term aging (100 h) at 650°C on the LCF behavior of a 10%Cr steel was studied at 650°C and room temperature.

It was revealed that aging has a positive effect on the fatigue life. This is especially clearly observed when tested at elevated temperature. The LCF behavior of the 10%Cr steel aged for 100 h followed a Basquin-Manson-Coffin and Morrow relationships. The parameters of the equations are defined for all states. Effect of presence of the fine Laves phase particles on the LCF resistance is discussed.

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