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Effects of loading frequency on cyclic deformation and fatigue behavior of metastable austenitic stainless steels

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In order to evaluate the true durability of a material or component a sufficiently high number of fatigue tests performed at a number of cycles higher than the classical fatigue limit must be executed, which, in turn, implies that normally pronounced time consumption and high costs are involved. This issue can be addressed using high frequency test systems, allowing the performance of cyclic loading tests in high to very high cycle fatigue regime in a reasonable time. However, the likely influences of the test frequency on the material response must be considered. For this reason and because metastable austenitic steels are well known for their strain rate sensitivity, the steel AISI 304 was analyzed regarding the influence of load frequency on the cyclic response and fatigue behavior. Fatigue tests were performed at load frequencies of 100 Hz and 1000 Hz using two resonance pulsation test stands, as well as by means of a servo-hydraulic test machine at 1 Hz and 50 Hz. The cyclic deformation behavior was characterized based on the evaluation of stress-strain hysteresis loops and temperature measurements. The deformation-induced phase transformation from γ -austenite to α' -martensite was globally and locally evaluated by means of magneto-inductive measurements and EBSD analysis, respectively. The analyses showed that higher amounts of α' -martensite and lower plastic strain amplitudes are observed when the cyclic experiments are carried out at lower frequency, promoting higher fatigue strengths.

Biography

Davi Pessoa has completed a mechanical engineering and has MSc degree in materials science from Federal University of Rio Grande do Sul. He has worked for more than 8 years in the automotive field and 4 years as Scientific Researcher in the Fraunhofer Institute for Material and Beam Technology and at the meantime as Guest Researcher in the Technical University of Dresden and did his PhD studies. He has published 8 papers and has been serving as a Reviewer of a reputed journal.

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