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Experimentelle Untersuchung der Mikrostruktur sowie des Verformungs- und Umwandlungsverhaltens zyklisch beanspruchter metastabiler austenitischer Stähle

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Kurzfassung

In this investigation, mechanical stress-strain hysteresis, temperature and magnetic measurements were performed to characterise the cyclic deformation behaviour of the metastable austenitic steels AISI 304, AISI 321 and AISI 348 with particular attention to the deformation-induced martensite formation. Plastic-strain-controlled single step tests were performed at ambient temperature with a load ratio of $R_\varepsilon = -1$ and a frequency of 0.2 Hz. The process of martensite formation can be modeled as a function of the cumulative plastic strain and the cumulative strain energy density. The both parameters were embedded in a new model for the description of the deformation-induced martensite formation under cyclic loading. Furthermore, plastic-strain-controlled two step and random loading tests were performed. The deformation-induced martensite fraction as well as changes of the magnetic field due to the Villari effect were measured in-situ with a Ferritescope sensor. The ratio of the change of the magnetic field to the martensite fraction was used as criterion to qualify the fatigue state of metastable austenitic steels. The microstructural changes could be shown in light micrographs.

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