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**Abstract**

According to their excellent mechanical and technological properties, i.e. high toughness, as well as their corrosion resistance the investigated austenitic steels X6CrNiTi1810 (1.4541, AISI 321), X10CrNiNb189 (1.4546, AISI 348) and X5CrNi1810 (1.4301, AISI 304) are widely used, e.g. in power stations and in chemical plant constructions. In these applications, structural materials are usually subjected to variable mechanical and temperature loadings which result in fatigue. The aim of the present work is the systematic microstructure-oriented investigation of the interrelation between the plasticity-induced martensite formation and the cyclic deformation behavior of metastable austenitic steels. The focus lies on the interactions between the cyclic loading conditions e.g. amplitudes and frequencies and the resulting microstructural changes. The plasticity-induced martensite formation can be detected with magneto-inductive methods and be assigned to the plastic deformation and thus in good approximation to the actual state of fatigue damage. One aim of the present work is the on-line monitoring of austenitic components in service with regard to an estimation of the residual time.

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