Low Cycle Fatigue behaviour of Al-TRIP steels

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ABSTRACT

TRIP steels are new generation high strength steels, which benefit from the Transformation Induced Plasticity (TRIP) effect to exhibit high strength and uniform elongation values accompanied by a gradual strain hardening during plastic straining [1]. Their Low Cycle Fatigue (LCF) behaviour is also influenced by the martensitic transformation phenomenon, which is triggered by the plastic strain component involved in the cyclic loading [2-4]. Experimental results suggest that the martensitic transformation has a negative impact on LCF performance [5], however the phenomenon has not yet been thoroughly investigated, with regard to the TRIP steel RA microstructural characteistics.

In the present experimental study the cyclic behavior of Al-TRIP steels with similar chemical composition subjected to different heat treatment conditions has been examined, which result in varying initial retained austenite characteristics. LCF experiments have been conducted to assess the cyclic response and strain-life curves of the materials. In the experimental results the magnitude of applied plastic cyclic strains on the materials cyclic behavior is evaluated and basic microstructural influences are discussed with regard to the obtained cyclic behavior of the materials.

The experimental results show that LCF performance is dependent on the RA microstructure and magnitude of plastic cyclic strains, influencing the driving force for martensitic transformation. The cyclic material response is characterized by cyclic softening at low strain amplitudes with a gradual transition to cyclic hardening at high strain amplitudes. Extensive cyclic hardening at high strain amplitudes leads to degradation of the LCF performance. On the contrary, at lower strain amplitudes corresponding to the transition fatigue life, cyclic softening prevails, and the less stable RA microstructure against transformation enhances LCF performance.

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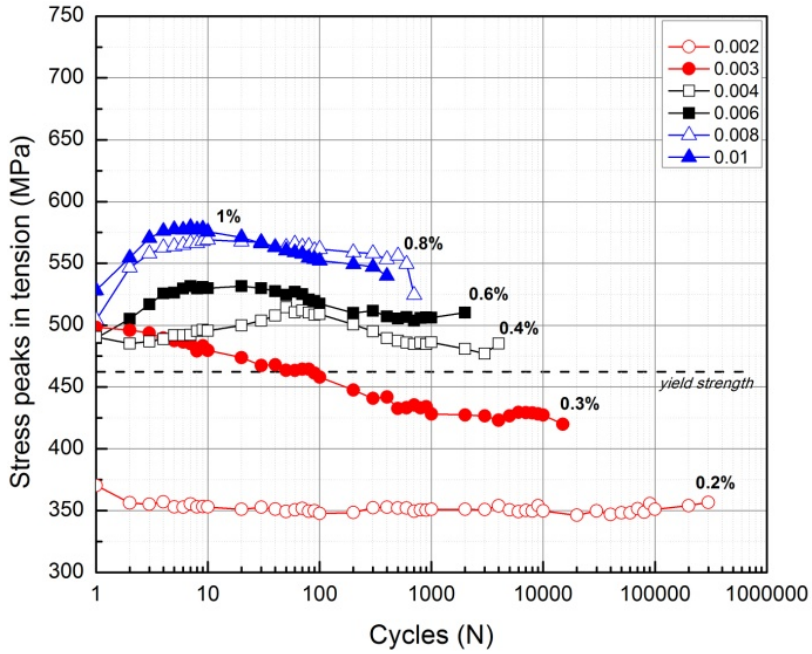

Figure 1: Cyclic behavior of Al-TRIP steel with increasing strain amplitude

References

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