

Fatigue crack initiation and the role of deformation twins in CrCoNi medium-entropy alloy

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Multi-principal-element alloys became a topic of significant interest thanks to their outstanding mechanical properties at room and low temperatures. However, there is still lack of the information about their fatigue properties. In current work, the attention is focused on model system, equiatomic CrCoNi alloy in fully recrystallized microstructural state which combines good cyclic strength with superior resistance to cyclic plastic deformation. The cyclic plastic localization and its role in the fatigue crack initiation during low cycle fatigue loading were studied in two stages of fatigue life – at the peak of cyclic stress and at the fracture. A sophisticated experimental workflow was designed to extract information from the surface and the bulk of tested material using a combination of SEM, EBSD, ECCI, FIB and HR-STEM. High fraction of annealing twin and the fatigue induced deformation twin boundaries were preferential sites for localized cyclic plastic strain. Moreover, stress concentrations near deformation twins led to activation of TWIP and TRIP plasticity and early, well-development of surface relief. Experimental results obtained using several STEM and SEM characterization techniques are complemented by atomistic modeling of the local stress states in association with different twin sizes under an applied load.

Keywords: High-entropy Alloys, Fatigue crack initiation, PSB, Deformation twin

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References:

[1] Heczko M., Mazánová V., Slone C.E., et al., Scripta Materialia, 202, 2021, 113985