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Effect of Microtexture on Short Crack Propagation in Two-Phase Titanium Alloys

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Abstract

Short crack propagation is difficult to predict because it is highly microstructure sensitive. In this paper, the short crack propagation behaviour in a two-phase titanium alloy Ti-6Al-4V with the presence of strong microtexture and macrozones is investigated using four-point bend fatigue test. We used four factors to characterize the resistance of grain boundaries to short crack propagation: the favourability of slip systems, the slip transmission through grain boundaries, the alignment of crack planes in neighbouring grains and the effective driving force on tilted crack plane. The influences of these factors on the short crack propagation resistance are investigated by detailed interpretation of the short crack propagation through grain boundaries between grains with similar orientations and through grain boundaries between grains with different orientations. The effect of microtexture and macrozones on short crack propagation resistance in two-phase titanium alloys is also discussed. Based on our new methodology we find that favourable slip systems in the outgoing grain, good alignment of the crack planes and high effective driving force on the outgoing crack plane are ideal for the crack transmission onto a slip plane through grain boundaries with minimal resistance. In contrast, low alignment of the favourable slip plane with the incoming crack plane increases the resistance at the grain boundary and changes the direction of the short crack propagation. In a macrozone oriented favourably for basal<a> or prismatic<a> slip systems, the short crack growth is non-deviated with minimal resistance on the grain boundaries. In this study, a