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Effect of Loading Frequency on Fatigue Properties of Ni-base Super Alloy Inconel 718

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Summary

Fatigue tests under rotating bending and ultrasonic loading were carried out using plain specimens with different grain sizes of Ni-base super alloy, Inconel 718, in order to investigate the effects of grain size and loading frequency on fatigue properties. Fatigue strength was increased with decreasing in grain size under both tests. Moreover, the fatigue strength under ultrasonic loading was higher than that under rotating bending. The resistance to crack initiation was larger in smaller grain sized alloy under both tests, and larger under ultrasonic loading than under rotating bending. Effects of loading frequency and grain size on crack initiation were explained from the points of view of the effects of those on flow stress. On the other hand, the effect of grain size on crack growth rate was small in both loading conditions. The crack morphology was rougher in the larger grain sized alloys, meaning that the crack growth in the larger grain sized alloys was suppressed by roughness induced crack closure effect. However, flat facets caused by twin boundary cracking and intergranular cracking were observed in the larger grain sized alloys, which inversely led to crack growth acceleration. Consequently, the effect of grain size on crack growth rate was decreased.