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[Invited Oral] High-cycle fatigue properties of Alloy718 base metal and electron beam welded joint

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Tensile and high-cycle fatigue properties of Alloy 718 10 mm-thickness plate and its welded joint were investigated at 293 K and 77 K in this study. The welded joint for the plate was manufactured using electron beam welding (EBW) and followed by a solution treatment and a conventional double aging. After these heat treatments, the hardness of the welded zone became about HV470 same as that of the base metal. The 0.2% proof stress ($_{0.2}$) and the tensile strength ($_{B}$) of the base metal and the EBW joint increased with a decrease in temperature, without decreasing elongation. The $_{0.2}$ and the $_{B}$ of the EBW joint reached about 94% of those of the base metal at both temperatures. Fatigue tests were carried out under uniaxial loading for up to 10^7 cycles at stress ratio of R=-1. The base metal and the EBW joint exhibited the similar high-cycle fatigue properties at 293 K. The fatigue strengths of these samples increased at 77 K. However, the EBW joint specimens fractured in longer life region, resulting in the same fatigue strength at 10^7 cycles as that at 293 K. SEM observations of the fractured EBW joint specimens revealed that fatigue crack initiated from specimen surface at 293 K, and often from blow holes formed in the welded zone at 77 K. Thus, it could be concluded that fatigue crack initiation from blow holes tend to be caused more frequently at low temperatures and degrades high-cycle fatigue strength of the EBW joint.

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