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微观组织对TA15 ELI钛合金损伤容限性能的影响

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摘要: 研究了TA15 ELI 钛合金43 mm厚板的等轴组织、双态组织和片层组织的室温拉伸性能、断裂韧性(K_{IC})以及疲劳裂纹扩展速率(da/dN)等损伤容限性能, 通过金相显微镜观测了疲劳裂纹在各类组织中的扩展规律, 讨论显微组织对该合金损伤容限性能的影响。结果表明: 该合金等轴组织和双态组织的室温力学性能和疲劳裂纹扩展阻抗差别不大; 相对等轴组织和双态组织而言, 该合金片层组织在损失强度较小的前提下($R_m=992$ MPa), 合金断裂韧性提高, 达到 $111 \text{ MPa}\cdot\text{m}^{1/2}$, 同时该合金的疲劳裂纹扩展速率也大幅降低, 其Paris公式拟合参数为: $c=1.08 \times 10^{-8}$, $n=3.23$, 具有更好的损伤容限性能。

关键字: TA15 ELI钛合金; 疲劳裂纹; 扩展速率; 断裂韧性; 损伤容限

Effects of microstructure on damage tolerance properties of ta15 eli titanium alloy

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Abstract: The damage tolerance behavior of TA15 ELI alloy 43 mm plates with equiaxed, bi-modal and lamellae microstructure were studied, including tensile properties, fracture toughness and fatigue crack propagation behavior. The effects of microstructure of TA15 ELI alloy on the damage tolerance were discussed. The results show that the equiaxed and bi-modal microstructures have the similar mechanical properties and fatigue crack propagation rate. The plate with lamellae microstructure has higher fracture toughness about $111 \text{ MPa}\cdot\text{m}^{1/2}$ and fatigue crack propagation resistance, and its strength lose is less compared with that of bi-modal microstructure, which indicates that the lamellar microstructure has better damage tolerance behavior.

Key words: TA15 ELI titanium alloy; fatigue crack propagation rate; fracture toughness; damage tolerance

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