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论文

定向凝固Ti--50Al合金组织演化及其片层取向控制

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摘要:

对Ti-50Al(原子分数, %）合金在较宽的生长速率范围内进行定向凝固实验, 研究了生长速率对固/液界面形态、微观组织演化及片层结构形成的影响. 发现合金在1-5 μm/s的速率范围内均以*α*胞晶单相生长, 最终形成全片层结构; 当生长速率达到10 μm/s时, 在初始凝固的较长距离内为*α*胞晶单相生长, 随着凝固的进行, 胞晶间溶质逐渐富集, 晶间出现从液相析出的*γ*相, 最终不能形成全片层结构; 当生长速率大于15 μm/s时, 合金以α枝晶生长, 枝晶间也出现*γ*相. 对各生长速率下形成的片层结构取向的分析表明, 片层结构取向与定向凝固启动界面处铸态晶粒的取向的历史有关. 根据上述规律, 以Ti-50Al合金为籽晶和主体合金, 选择确保*α*单相凝固的生长速率8 μm/s, 进行片层取向控制, 最终获得取向与生长方向一致的全片层结构.

关键词： Ti-50Al合金 定向凝固 组织演化 片层

STRUCTURE EVOLUTION OF DIRECTIONALLY SOLIDIFIED Ti--50Al ALLOY AND LAMELLAR ORIENTATION CONTROL

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Abstract:

Ti-Al alloys as the high temperature structural material with the most prospective development are widely used in aerospace. Further study should been conducted on their formation of fully lamellar structure in
directional solidification and lamellar orientation control for a good balance of mechanical properties. Directional solidification
experiments were conducted for Ti-50Al (atomic fraction, %) alloy in a relatively wide range of growth rates. The
effects of growth rate on interfacial morphology, microstructure evolution and formation of lamellar structure were
investigated. A single-phase growth of cellular *α* was observed in a growth rate range of 1-5 μm/s, and finally a fully
lamellar structure was formed. When the growth rate reached 10 μm/s, a single-phase growth of cellular *α* was
also observed during a relatively long distance after initial solidification, but as solidification proceeded, intercellular
solute enrichment became so severe that *γ* phase precipitated from liquid appeared between *α* cells, and finally a full
lamella can not be formed. When the growth rate was higher than 15 μm/s, a dendritic growth of *α* phase and *γ*
phase between α dendrites were observed. The analysis on the final lamellar orientations at different growth rates
showed that the lamellar orientation is history-dependant on the orientation of as-cast grain at the started interface of direcitonal
solidification. Based on the above rules, Ti-50Al alloy, also as seed, was solidified under controlling the lamellar orientation, and a relatively low growth rate of 8 μm/s was chosen to ensure a single-phase growth of α.
Finally, a fully lamellar structure with an orientation parallel to the growth direction was obtained.

Keywords: Ti--50Al alloy directional solidification structure evolution lamella

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