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DZ125定向凝固高温合金长期时效后的显微组织和超高周疲劳行为

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Microstructures and Ultra-high Cycle Fatigue Behaviors of Directionally Solidified Superalloy DZ125 After Long-term Aging

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摘要

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摘要 选用950 °C时效温度,对DZ125定向凝固高温合金进行了500、1 000、1 500 h的长期时效。利用超声疲劳试验机测试了合金的超高周疲劳性能。采用扫描电子显微镜、透射电子显微镜和电子背散射衍射(EBSD)研究了合金的显微组织和超高周疲劳行为。结果表明:长期时效对DZ125合金的组织稍有影响,长期时效后合金的点阵错配度降低,随着时效时间的延长, γ' 相聚集长大更加明显,未出现拓扑密排相(TCP)等有害相;长期时效对DZ125合金的超高周疲劳性能稍有影响,随着时效时间的延长,疲劳性能呈下降趋势,疲劳断口较平整,裂纹起源于试样的表面,在超高周疲劳后合金的晶粒发生了小幅度旋转。

关键词: 定向凝固 高温合金 长期时效 超高周疲劳 疲劳断口 裂纹

Abstract: Directionally solidified superalloy DZ125 is aged at 950 °C for 500 h, 1 000 h and 1 500 h, respectively. The ultra-high cycle fatigue property of alloy DZ125 is measured using an ultrasonic fatigue test machine. The microstructures and ultra-high cycle fatigue behaviors of DZ125 are investigated using scan electron microscopy, transmission electron microscopy and electron backscatter diffraction (EBSD) technique. The results show that the effect of long-term aging heat treatments on the microstructures of DZ125 is small, and the lattice misfit is reduced after long-term aging. With the increase of the aging time, γ' phases accumulate and grow obviously, but the topologically close packed(TCP) phase is not found. The effect of long-term aging heat treatments on the ultra-high cycle fatigue properties is small. With the increase of the aging time, the ultra-high cycle fatigue property shows a downward trend. The fatigue fracture surface is perpendicular to the stress axis/fatigue cracks initiate from the sample surface, and the grain rotation angle is small after ultra-high cycle fatigue tests.

Keywords: directionally solidification superalloy long-term aging ultra-high cycle fatigue fatigue fracture cracks

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