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ZSGH4169合金细观力学行为的数值模拟

Numerical simulation of meso-mechanical response for superalloy ZSGH4169

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中文关键词： 循环塑性 晶体滑移 各向异性屈服硬化 Bauschinger效应 双轴

英文关键词:cyclic plasticity crystal slip anisotropic yield hardening Bauschinger effect biaxial

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中文摘要:

基于晶体塑性本构理论,利用多晶代表性单元从细观尺度研究了ZSGH4169合金在650℃条件下考虑双轴应力状态的循环应力应变行为.计算结果表明:该合金在双轴拉伸应力控制下存在与低周疲劳试验常用的单轴应力状态一致的棘轮效应.对两种应力状态下的结果进行对比发现,在1150MPa应力单轴循环载荷下初始循环残余应变比双轴应力状态高出3倍,且双轴应力状态下最终循环稳定,残余应变约为1.2%,但在单轴应力状态下是不稳定的.对应力和塑性应变累积不均匀性的分析表明:单轴和双轴拉伸状态下,虽然应力和应变分布的不均匀性都随着循环数的增加而增加,但单轴拉伸状态下平均应力随循环数增加,而双轴拉伸状态下几乎为常数.

英文摘要:

Based on crystal plasticity constitutive theory, polycrystalline representative volume element (RVE) was used to investigate the cyclic stress/strain response of superalloy ZSGH4169 in meso scale under multiaxial stress state at 650℃. The simulations reveal that ratcheting is significant under biaxial load control, which is consistent with uniaxial stress state commonly conducted in low cycle fatigue tests. The comparison of the two stress states indicate that the residual strain of initial cycle under uniaxial stress state is three times of that under biaxial condition at 1150MPa. Meanwhile, the residual strain, which is about 1.2%, is stable under the biaxial stress, but the uniaxial condition is unstable. Analysis of inhomogeneity for the plastic strain accumulation and stress further shows that the inhomogeneity of the stress and strain will increase with the cycles under both conditions. However,the average stress increases with cycles under uniaxial conditions while it will remain almost constant under biaxial conditions.

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