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IC10合金热机械疲劳性能与寿命预测

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摘 要：600~1 100 ℃时对IC10合金进行同相位、反相位、135°相位和−135°相位的应变控制热机械疲劳实验。发展了一种三参数幂函数能量方法的寿命预测方法，并用于材料的热机械疲劳寿命预测。对Manson-Coffin方程、拉伸迟滞能模型(Ostergren)、基于微裂纹扩展模型的能量方法和三参数幂函数能量方法热机械疲劳寿命预测能力进行评估，结果表明：材料的热机械疲劳应力—应变滞后回线的形状与温度—机械载荷之间的相位角有关；温度—机械载荷之间的相位角对材料的热机械疲劳性能有一定的影响；三参数幂函数能量方法物理意义明确，形式简单，寿命预测结果分布在2倍的分散带内，可以用来预测IC10合金的热机械疲劳寿命。

关键字： IC10合金；热机械疲劳；同相位；反相位；寿命预测

Thermomechanical fatigue performance and life prediction in superalloy IC10

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Abstract: Four types of test thermomechanical fatigue including in-phase, out-of-phase, 135° phase angle and −135° phase angle were performed on superalloy IC10, at a temperature ranging from 600 to 1 100 ℃. A three-parameter strain energy function was developed for thermomechanical fatigue (TMF) life. The life prediction capability of Manson-Coffin equation, Ostergren method, the model based on microcrack propagation and a new method were evaluated by using superalloy IC10 TMF data. The experimental results show that the stress—strain loop depends on the loading form. The phase angle between the temperature and mechanical loading affects the thermomechanical fatigue life. The results of TMF life prediction show that this new method is better than Manson-Coffin equation, Ostergren method and the model based on microcrack propagation, so this new method can be used to predict the TMF life of superalloy IC10.

Key words: superalloy IC10; thermomechanical fatigue; in-phase; out-of-phase; life prediction

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