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### 腐蚀条件下LD2航空铝合金裂纹扩展规律研究

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### Fatigue Crack Growth Behavior of Aerospace Aluminum Alloy LD2 Under Corrosion

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摘要

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#### 摘要

腐蚀损伤会加速飞机结构的疲劳裂纹扩展,缩短飞机疲劳寿命。以LD2航空铝合金材料为研究对象,通过在实验室内模拟飞机服役环境进行加速腐蚀试验,得到不同腐蚀时间下的试验件,并在MTS-810疲劳机上对不同腐蚀时间下的试验件进行疲劳试验,得到不同腐蚀年限下的疲劳断口形貌。通过断口判读分析,得到不同腐蚀年限下的裂纹扩展数据( $a, N$ )。从不同腐蚀时间下的裂纹扩展数据研究分析,得到裂纹长度与循环次数符合指数函数的形式,即裂纹扩展速率与裂纹长度成正比,其斜率依赖于腐蚀损伤与疲劳载荷两个因素,而且在同一应力水平下,其斜率与腐蚀时间呈线性关系,并且其截距与应力水平也呈线性关系。

关键词: 铝合金 腐蚀损伤 疲劳断口 裂纹长度 疲劳裂纹

#### Abstract:

Corrosion damage increases fatigue crack growth rates of aircraft structures, and shortens the fatigue life of an aircraft. Accelerated corrosion tests simulating the service environment of aircraft and then the fatigue tests on aerospace aluminum alloy LD2 test samples are executed under different corrosion times. The fatigue rupture morphologies of the test samples with different corrosion times are obtained. The crack growth data ( $a, N$ ) under different corrosion times are measured by judgment of the rupture morphologies. By fitting the data ( $a, N$ ), it is found that the relationship between crack length and cycle number is exponential, and the crack growth rate is directly proportional to the crack length, while the slope of the crack growth rate vs the crack length depends on the factors of corrosion damage and fatigue load level. Furthermore, by fatigue tests under different corrosion times and different stress levels, it is also found that the relationship between the slope and the corrosion time is linear under the same stress level and the slope values under different stress levels are nearly the same, while the intercept of the lines of crack growth rate also varies linearly with the stress level.

Keywords: aluminum alloy corrosion damage fatigue rupture morphology crack length fatigue crack

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