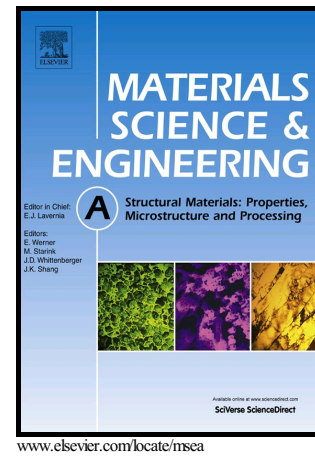


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Over-aging influenced matrix precipitate characteristics improve fatigue crack propagation in a high Zn-containing Al-Zn-Mg-Cu alloy

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Abstract:

A high Zn-containing Al-Zn-Mg-Cu alloy was researched due to excellent overall performances. The hardness, electrical conductivity and mechanical properties were investigated and detailed aging parameters subjected to T6, T79, T74 and T73 were proposed. The matrix precipitates of various aging tempers were investigated by transmission electron microscope (TEM) and high-resolution transmission electron microscope (HREM) techniques and quantitative information of matrix precipitates was extracted from the bright-field TEM images projected along $\langle 110 \rangle_{\text{Al}}$ orientation with the aid of an imaging analysis. The fatigue crack propagation (FCP) behaviors subjected to different aging tempers were investigated, the related fracture morphology of the stable expanding regions was analyzed and corresponding fatigue striations were measured to verify the FCP rates. The results showed that with the deepening of aging degree, the matrix precipitates coarsened with an expanding of precipitate size distribution and an enlargement of average precipitate size while the precipitates evolved from GP zones and η' phase to η' phase and η phase. The FCP resistance was improved with the aging degree deepens and the evolution of related tearing ridge, tearing dimple and fatigue striation also proved it. Due to a smaller cyclic plastic zone of the alloy with various tempers compared with the average grain size, the FCP rate was significantly influenced by matrix precipitate characteristics and a theoretical model which directly correlated FCP rate with matrix precipitate characteristics was proposed. From T6 state to T73 state, the enlargement of cuttable GP zones and η' phase, its evolution to η phase and the nucleation, growth and coarsening of η phase were in favor of enhancing the FCP resistance.

Keywords:

Al-Zn-Mg-Cu alloy; Fatigue crack propagation; Precipitate; Aging treatment

1. Introduction

As a high-strength, precipitate-hardened Al alloy, the Al-Zn-Mg-Cu alloy has been applied

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