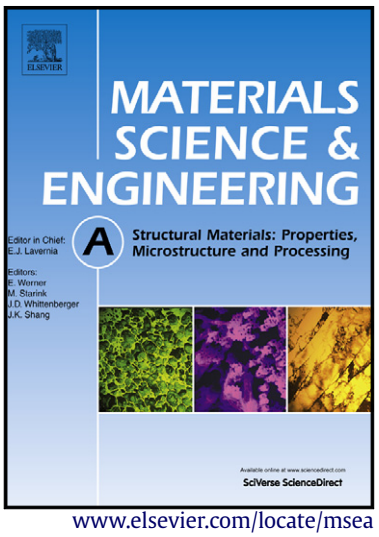

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Effects of Ag variations on the microstructures and mechanical properties of Al-Cu-Mg alloys at elevated temperatures

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Abstract

Microstructures and mechanical properties of Al-Cu-Mg alloys containing various Ag additions were investigated by a combination of the tensile testing and quantitative transmission electron microscopy (TEM) analysis. Our results indicated that an increase of Ag from 0.46 to 0.88 wt.% promoted the precipitation of Ω phase, thereby leading to the noticeable improvement on the strength properties of the underaged Al-Cu-Mg alloys at various temperatures. This enhanced precipitation of Ω phase was also accompanied by the suppressed formation of θ' phase. Despite further exposing at 300℃ lead to a pronounced decrease in the number density of Ω phase, the higher plate number density was still revealed in 0.88Ag alloy rather than 0.46Ag alloy. Moreover, quantitative TEM results of the studied alloys highlighted the differences in the coarsening kinetics of Ω phase during further exposing at 300℃. Ω phase tended to experience a transition from the plate thickening to the plate lengthening by increasing Ag at 300℃. Our results also present the positive effect of pre-aging at 165℃ for 2h on retarding the thickening kinetics of Ω phase at 300℃.

Keyword: Al-Cu-Mg-Ag alloy; microstructure; Ω phase; Ag variations; transmission electron microscopy

1. Introduction

Trace additions of Ag is well known to accelerate the aging hardening response of Al-Cu-Mg alloys by producing a dense precipitation of Ω phase that nucleates and grows as thin hexagonal-shaped plates on the $\{111\}_\alpha$ planes [1-3]. Ω phase exhibited excellent thickening resistance at elevated temperatures [4,5] and contributed to a combination of the high strength properties and excellent heat resistance of Al-Cu-Mg-Ag alloys. Position Sensitive Atom Probe (POSAP) study by Grovenor et al. [6,7] proposed that Ω phase was richer in Mg and Ag but contained a lower Cu concentration than θ phase. However, atom probe tomography (APT) study concerning the nucleation and growth of Ω phase demonstrated that Ω was chemically equivalent to θ phase with extra Mg-Ag co-segregation layer at α/Ω interface [8].

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