A STUDY ON THE HIGH TEMPERATURE MECHANICAL PROPERTIES OF MECHANICALLY ALLOYED Al-10Ti ALLOY

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ABSTRACT

The high temperature tensile, stress rupture, and fatigue properties of Al-Ti alloys produced by mechanical alloying, followed by hot extrusion, were investigated.

Ultimate tensile strength had no much difference up to 100℃ compared to the conventional precipitation hardened aluminum alloys (2014-T6, 2219-T18) but was three times as much as those of the conventional aluminum alloys above 200℃ because of restraint of dislocation movement and grain boundary sliding by a fine dispersion of Al_3Ti, Al_4C_3 and Al_2O_3.

Stress rupture strengths of MA Al-0 wt.% Ti, MA Al-10 wt.% Ti alloys at 300 ℃ were two and three times higher than those of the conventional precipitation-hardened Al alloys, respectively, because the dislocation mobility was reduced effectively by the presence of thermally stable dispersoids.

Room temperature fatigue strength of MA Al-10 wt.% Ti alloy was similar to that of Al 7075 but superior to Al 2024. The fatigue strength decreased as the temperature increased from room temperature to 300℃, and 400℃, and the number of crack initiations at the surface and secondary cracks were increased.

INTRODUCTION

In the development of high temperature Al alloy to replace Ti in aerospace skin and substructure applications, Al-Ti based alloy have been studied because Al_3Ti precipitate has high oxidation resistance and low density($3.3g/cm^2$), and also because Ti in the Al matrix has low diffusion rate (D482: $1.7cm^2/s \times 10^{-4}$) and low solubility. But, due to the differences in melting point (Al: 660℃, Ti: 1670℃) and specific gravity (Al: $2.70g/cm^3$, Ti:$4.51g/cm^3$) between Al and Ti, the coarsening of precipitate Al3Ti occurs in the conventional Ingot Metallurgy and even in the Rapid Solidification Process (RSP), and therefore, Al-Ti alloys have not been successfully produced.

In the Al-Ti alloy manufactured by Mechanical Alloying (MA), ultrafine Al_3Ti particles can be dispersed uniformly in the Al matrix because MA