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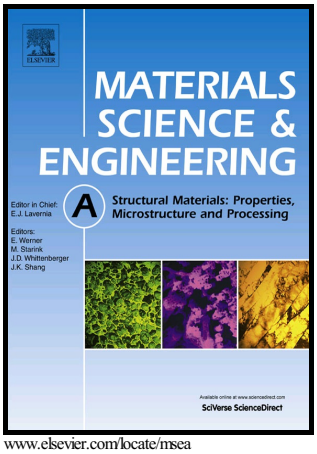

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Effect of strain rate and temperature on dynamic mechanical behavior and microstructure evolution of ultra-high strength aluminum alloy

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Abstract

The dynamic mechanical response of Al-Zn-Mg-Cu alloy with a high content of Zinc was studied using split Hopkinson pressure bar (SHPB) at strain rate of 1778 s^{-1}-6516 s^{-1} and temperature of 25 to 400 ºC. The microstructure evolution and fracture characteristics of this alloy were revealed from these studies. The obtained results show that the strain rate sensitivity is slightly positive below 3136 s^{-1}, but becomes negative at higher strain rates because of the development of adiabatic shear bands and cracks. From 25 to 400 ºC, the flow stress decreases and there is an obvious decline above 200 ºC due to occurrence of athermal softening. The dislocation microbands and geometrically necessary dislocation contribute to grain fragmentation. The fracture develops due to a combination of ductile and shear failure. This study in general provides a significant understanding on the relationship between microstructure evolution and mechanical behavior of high strength aluminum alloy under dynamic loading.

Keywords

Al-Zn-Mg-Cu alloy; high strain rates; thermal softening; microstructure evolution.

1. Introduction

Al-Zn-Mg-Cu (AA7xxx) alloys are widely used in aerospace applications and combat vehicles due to their excellent combination of properties such as high specific strength, good toughness and energy absorption capability [1, 2]. However, the alloys are subjected to