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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 °C. 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 °C, the flow stress decreases and there is an obvious decline above 200 °C 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

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