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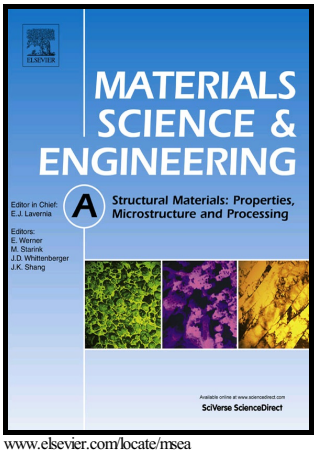

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The effect of boron addition on the high-temperature properties and microstructure evolution of high Nb containing TiAl alloys

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Abstract

The effect of boron addition on the microstructure evolution and high-temperature properties of Ti-43Al-6Nb-1Mo-1Cr alloys has been studied in this paper. With the boron content increasing from 0at.% to 1.0at.%, the ultimate tensile strength(UTS) at high temperature increase dramatically while the alloys with 1.0at%B exhibit UTS as 656.12±20.54MPa at 800°C, 642.43±14.44MPa at 850°C and 508.44±16.12MPa at 900ºC, respectively. Meanwhile, boron addition could stabilize the high-temperature UTS of the alloys in 500-700MPa with the temperature incresasing. Three types of strengthening mechanism in high-temperature strength caused by boron addition are also discussed and concluded.

Keywords: TiAl alloys; High-temperature properties; Microstructure evolution; Boron addition; Dislocations; Strengthening mechanism

1. Introduction

TiAl alloys have gained great interest for research on aerospace applications due to low density and high specific strength in recent years[1,2]. However, the insufficient high-temperature[3] strength decided the application and development of TiAl alloys. High-Nb TiAl alloys have been developed based on the traditional γ-TiAl alloys for this problem[4]. Boron addition was also an effective way for refinement and TiAl alloys strengthening [5,6]. The crystal structure and shape of the borides exhibited a large impact on the properties of TiAl alloys[7,8]. The reduction of boron concentration was attempted to avoid the long borides precipitates which induced premature cracking[9]. When nucleation takes place in borides from the β at high temperature, the α nucleation on borides surfaces or the possible α result in the refinement[10].

Tian[11] et al found that the increased quantity and volume fraction of the grain boundaries could provide the high strength for forged Ti-44Al-8Nb-0.2W-0.2B-0.1Y alloys with fine block-like γ/α_2 phases. Niu[12] et al forged the Ti-43Al-6Nb-1B alloys and found the broken borides could strengthen the alloys. The recent researches almost focus on the boron refinement for strengthening the TiAl