Influence of Composition and Breaking Process on Microstructure of Al-Fe-V-Si Heat Resistant Aluminum Alloy

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Key words: Solidification; Microstructure; wheel line speed; Al-8.5Fe-1.4V-1.7Si alloy.

Abstract: Alloy composition of thin strip Solidification Microstructure Effects of larger, Al-8.5Fe-1.4V-1.7Si and Al-11.7Fe-1.15V-2.4Si alloy. At 20 m / s and wheel line speed and 0.7 x 105Pa jet pressure difference process thin slices of tissue, can see in addition to changes in grain size and a-Al grain accounts for the proportion also vary. The Al-8.5Fe-1.4V-1.7Si alloying degree is relatively low, the alpha -Al grains occupy more volume fraction, while the Al-11.7Fe-1.15V-2.4Si alloy alpha -Al grain volume fraction is relatively small.

Introduction

In heat resisting Al-Fe-V-Si alloy composition system, Fe biggest non equilibrium solid solubility 6at.% and balance solid solubility only for 0.025at.%[1,2], in single roller melt spinning rapid solidification process of Fe with greater solubility limit, and Fe in the solid Al diffusion coefficient is very small, 427 C only 1.12×10-15cm2s-1[3,4]. Therefore in single roller spinning non equilibrium solidification produced a lot is not easy to change the al12 (Fe, V) 3Si phase, fine dispersed distribution in aluminum matrix, pinning of dislocations, hinder grain boundary sliding, improving recrystallization temperature, so as to improve the material of high temperature performance[5].

Materials and Methods

Alloy composition to strip the influence of solidification microstructure is larger, as shown in Figure 15 for the Al-8.5Fe-1.4V-1.7Si al-11.7fe-1.15v-2.4si alloy. At 20 m / s and wheel line speed and 0.7 x 105Pa jet pressure difference process thin slices of tissue, from the figure can see in addition to changes in grain size and a-Al grain accounts for the proportion also vary. The Al-8.5Fe-1.4V-1.7Si alloying degree is relatively low, the alpha -Al grains occupy more volume fraction, while the Al-11.7Fe-1.15V-2.4Si alloy alpha -Al grain volume fraction is relatively small. Fig.1 and Fig.2. Al-8.5Fe-1.4V-1.7Si al-11.7fe-1.15v-2.4si alloy strip energy spectrum analysis, distribution in a-Al grain had higher Fe element distribution and Si elements, and relative Al-8.5Fe-1.4V-1.7Si alloy, Al-11.7Fe-1.15V-2.4Si Fe alloy element distribution and Si elements distribution more, the reason may be heat-resistant phases al12 (Fe, V) 3Si phase caused by the precipitation.

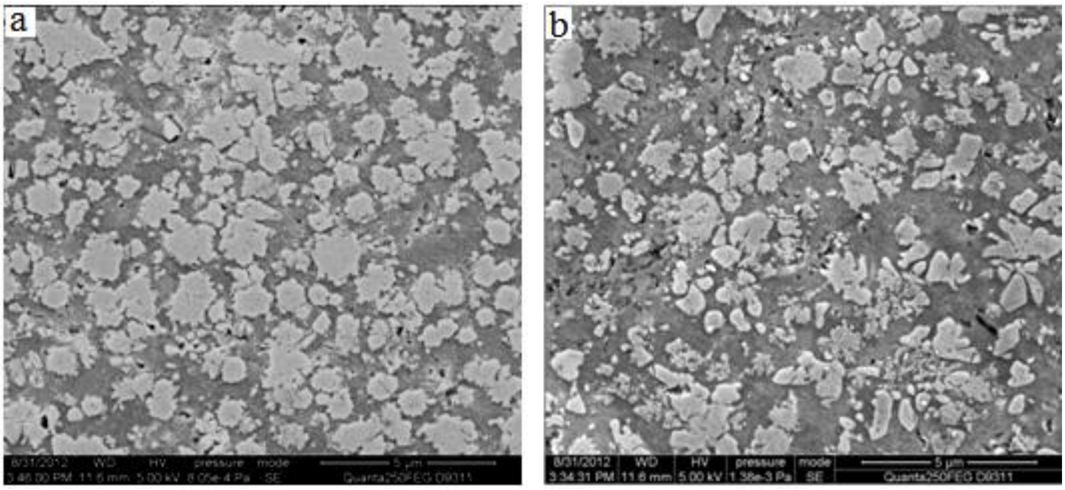


Fig.1 Effect of alloy composition on Microstructure of thin strip
(a) Al-8.5Fe-1.4V-1.7Si alloy (b) Al-11.7Fe-1.15V-2.4Si alloy

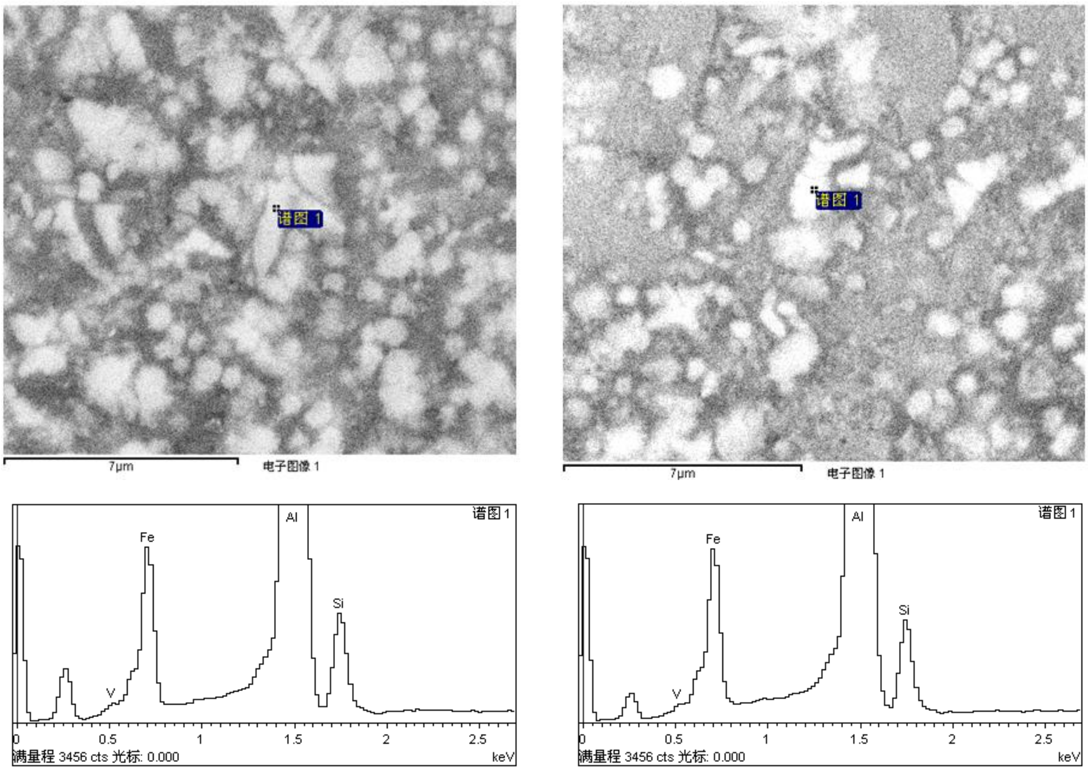
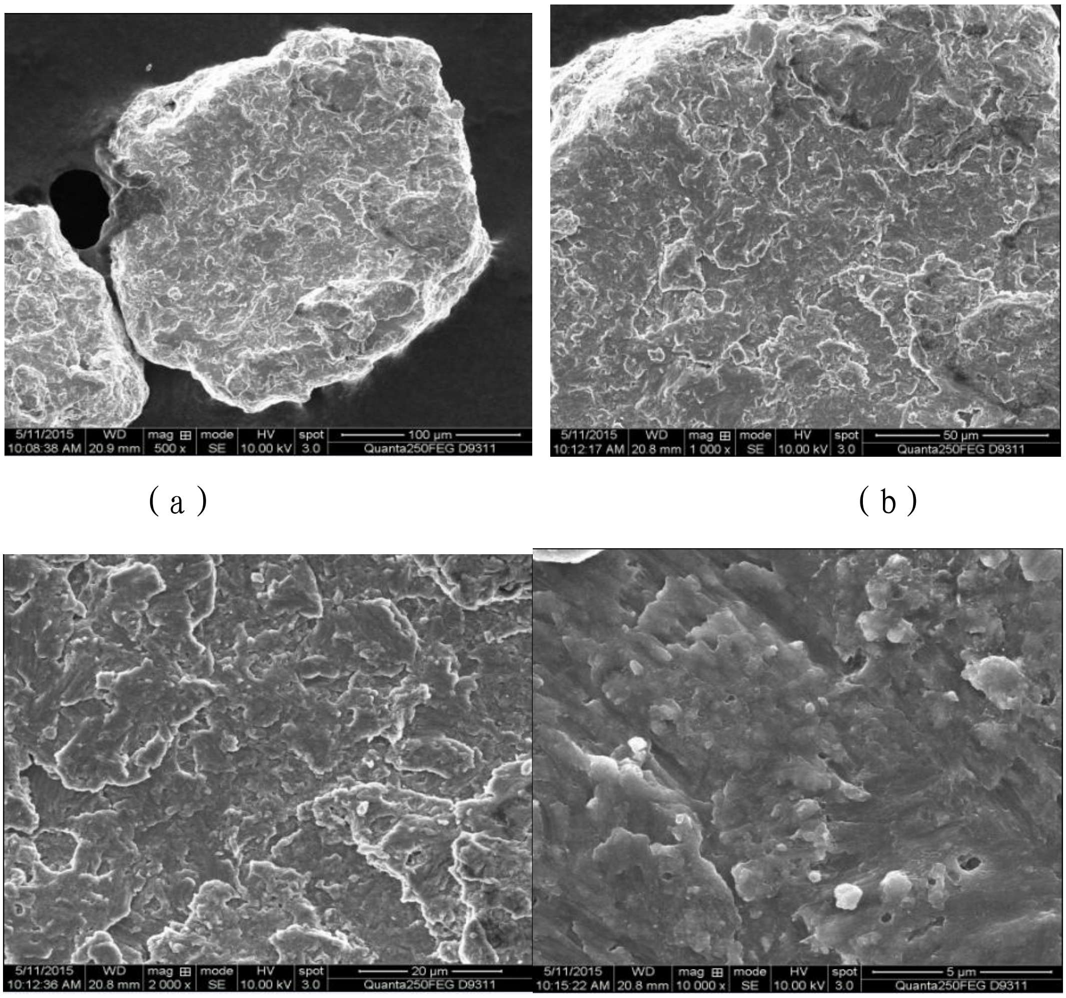


Fig.2 Thin band energy spectrum analysis
(a) Al-11.7Fe-1.15V-2.4Si alloy，(b) Al-8.5Fe-1.4V-1.7Si alloy

High energy ball milling, the ratio of the ball to material ratio was 40:1, the rotational speed was 180 min-1 / R, the ball milling time was 30 h, the ball milling process was protected by argon to prevent powder oxidation. After powder milling of 30 h, the metallographic examination showed that the powder particles were completely broken and irregular shape, and the whole structure of the powder particles was relatively uniform. The microstructure of the alloy prepared by powder is good.

As shown in Fig.3 and in Fig.4, high energy ball milling heat-resistant ultrafine alloy powder samples, after the test, alloy powder size on the cold and hot and hot pressing strength. Alloy powder particle size in the 40-50 project is good, large, cold and other static pressure sample bonding strength is small, the grain through the small high energy ball trials to achieve, and the impact of the strength of the sample bond strength is not.

Fig.3 High energy ball milling powder for heat resistant ultrafine microstructure alloy



(a) (b)

(c) (d)

Fig4 Microstructure of Al-11.7Fe-1.15V-2.4Si heat resistant aluminum alloy powder

Conclusion

The alloy powder, the main precipitation phase is al12 (Fe, V) 3Si phase; alloy powder by high energy ball milling, a-Al and al12 (Fe, V) 3Si phase diffraction peak width at half height increased significantly, indicating that after high energy ball milling Al-11.7Fe-1.15V-2.4Si alloy powder grain size decreases and grain refinement. At the same time al12 (Fe, V) 3Si phase peak width increases, intensity decreases, which may is the cause of solute atoms in solid solubility increases, Fe, V in the milling process partial dissolution of the alloy matrix caused by ball milling. As shown the surface microstructure of Al-11.7Fe-1.15V-2.4Si heat resistant aluminum alloy is micro morphology, and the presence of tough nest, which provides the material basis for subsequent hot pressing and hot extrusion forming.

References

[1] Ravichandran K S, Dwarakadasa E S. Advanced Aerospace Al alloy. Journal of Metals, 1987,39(5):28-32

[2] Dolowy J F. Increasing focous on A1licon carbide-reinforced composite.Light Metal Age, 1986, 44(56):7-14

[3] Lin S J, Liu K S. Effect of ageing on abrasing rate in an Al-Zn-Mg-SiC composite. Wear, 1988, 121(3): 1-l4

[4] Suganuma K, Fujita T, Suzuki N. Aluminium composite reinforced with new aluminium boate whisker. Journal of Materials Science Letters, 1990, 9(5):633-635

[5] Crawley E F. Material damping in Aluminium and metal materials composite.Journal of composite Materials, 1987, 21(6): 553-568