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The Modelling of Secondary Arm Space and Composition Difference in Dentrite of TiAl

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Abstract

The modelling of arm space in dendrite and composition has been built to analyze the inrtrinsic relationship of them. The uniformity has been maintained in the dendritic growth course in the solidification of TiAl which is a main destination and finding in this paper. It is found that the secondary arm space is 2.8nm with 0.1 of composition so the value is little in 0.4~0.53 composition. The arm space will increase with increasing composition difference. With increasing the secondary arm space the difference will be 1.5nm and 2.7nm in proportional when it is 0.1. It is known that the uniformed secondary arm space difference forms the dentritic structure in solidification of TiAl.

Keywords: Secondary arm space difference; Composition difference; Solidification; TiAl; Dentrite

Introduction

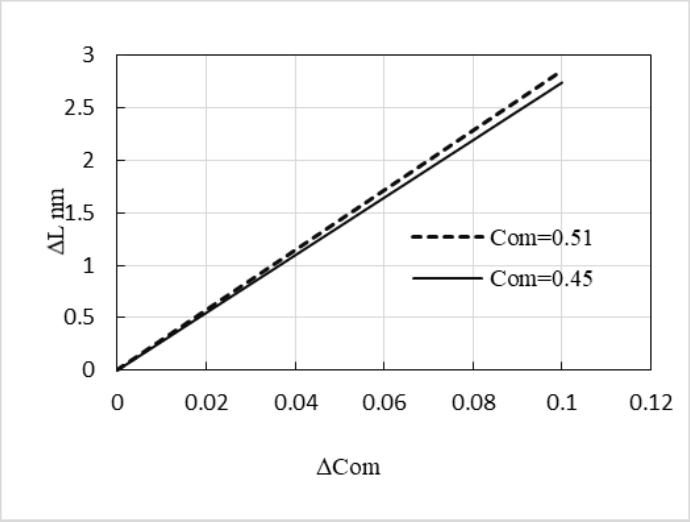
The change of secondary arm space in the solidification transformation can deduce the related formula. The curve expresses its trend better. From this relation their secondary dendrite arm space composition difference will change when the transformation happens. It is known that the arm space in solidification can solve their growth. In this study in terms of these equations the deduction and analysis is done. Here the equation is explored within line and find the intrinsic formula which make us to calculate the arm space correctly [1-3]. Therefore in this study the model of arm space difference and composition difference has been established to observe the trend and intrinsic relationship between them. The arm space difference has been discussed according to the graphs. To discuss the secondary arm space difference could be caused by the change of composition. This is the destination in this study. TiAl as a promise materials has been searched and developed for many years. However the secondary arm space difference with compositions difference is not searched yet, so in this study the equation is established through secondary arm space difference and composition difference according to the phase diagram. The research scope is from 0 to 1 of pure Al here. On the other side the relationship with arm space difference and composition difference has been investigated according to varied condition like composition and secondary arm space respectively for the application. To calculate the secondary arm space difference is our destination in the TiAl alloys [3-6]. In short the general research has been lied in the application but in this paper the whole dentritic growth is defined to find the situation.

Discussions and Modelling

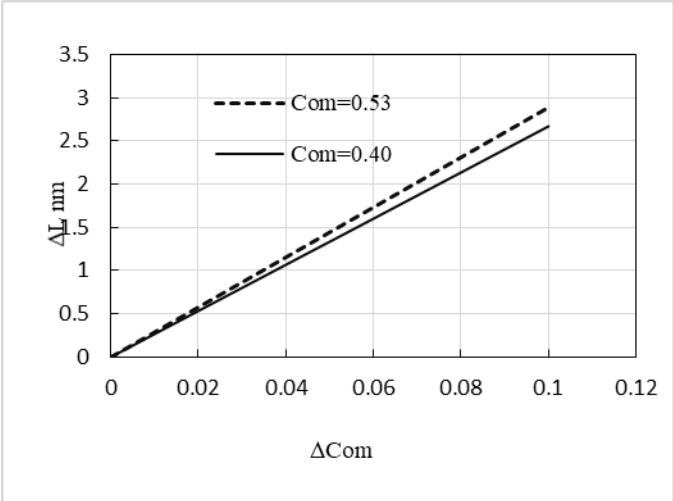
From the modelling of secondary arm space and composition difference in dendrite of TiAl the arm space is found nm scale. Through the change the composition and its difference & arm space length is observed little too. The composition arrangement is 0.4~0.53 meanwhile the arm space length is 20μm~40μm. Then the scope of observation has been 0~0.1 and 0~1 composition difference. Detail content including the equation is discussed as below (Figure 1).

From Figure 1(a~d) it is seen that the secondary arm space difference is from 0 to 2.7nm and 27nm that explains the change

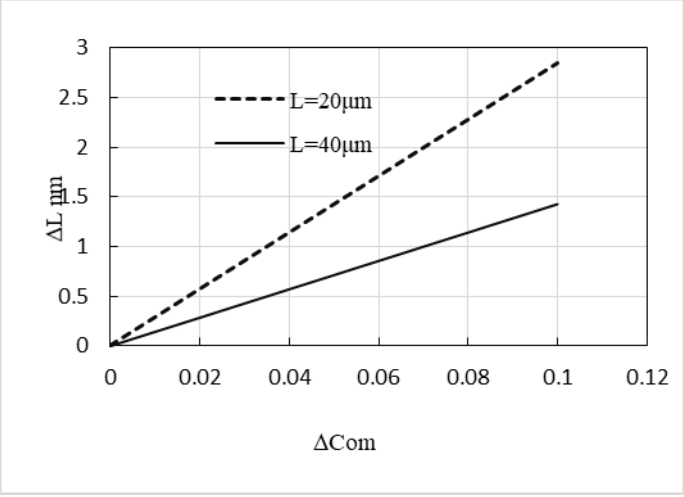
of arm space is little. It will increase when the composition difference changes from 0 to 0.1.



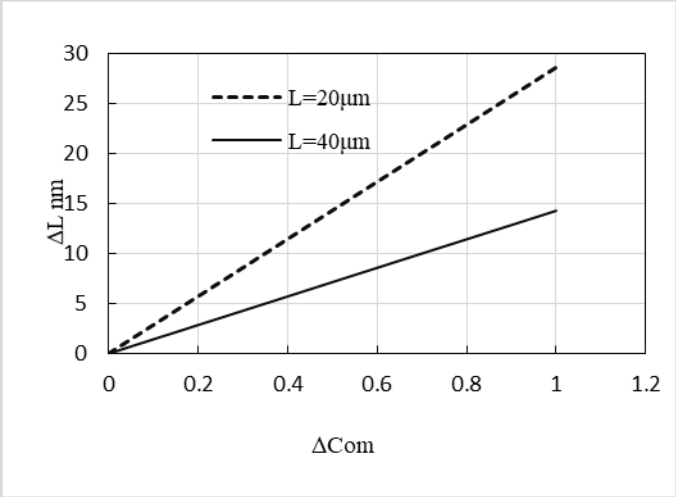
(a) Com=0.45~0.51



(b) Com=0.4~0.53



(c) L; ΔCom=0~0.1



(d) L; ΔCom=0~1

Figure 1: *The graph of secondary arm space difference and composition difference.*

In Figure 1 (a) the difference of arm space between composition difference with 0.45 and 0.51 is little meanwhile in Figure 1(c) it is big to two times with 2.7nm and 1.5nm respectively between secondary arm space with 20μm and 40μm. The composition is 0.52 in Figure 1 (c). In Figure 1(d) in the arrangement of ΔCom with 0~1 the proportional graph is gained with the same slope with Figure1 (c). The more arm space is the smaller the arm space difference will be. So the benefit is the bigger arm space who can bring littler arm space difference. As we know that the high cooling speed is low space difference under a certain property like mechanical tensile property and creep etc.

Since it has

$T=KL$ --- (1)

And $T=a*Com+b$ --- (2)

So it has

$K= (a*Com+b)/L$ --- (3)

Let Com=0.44 and L=20μm, it has

$K=36460$ --- (4)

Since too it has

$\Delta T=-1000\Delta Com$ ---（5）

And $\Delta T=36460*\Delta L$ --- (6)

It becomes

$\Delta L=0.027*\Delta Com$ ---（7）

Here T is temperature K; K is the constant; L is secondary arm space difference μm; a and b is constant too; Com is composition; ΔT and ΔL is the difference of temperature and secondary arm space respectively K & μm. ΔCom is the difference of composition Al.

When the arm space is constant 20μm and 40μm the space difference has little value. In special the composition difference becomes little with this deduced constant K. Maybe its value has

problem that needs us to further more research but the defining has been not wrong. Therefore the result exhibits the small secondary arm space difference one in solidification in TiAl alloys. That means that the change has been not too much so the uniformity has been maintained in the dendritic growth course in the solidification of TiAl which is main and destination and achievement in this paper. The dentritic secondary arm space difference has not been happened in this study. It means that the nm scale will be found to change, so the cooling rate is uniformed which is the main cause. If there is wave in cooling rate the arm space will change too. It has problem to control the cooling rate and dentritic growth. If the changed cooling rate will be a method to gain changed dentrite we want to. Besides the composition and secondary arm space will affect another effectiveness.

Conclusions

The secondary arm space difference is from 0 to 2.7nm and 27nm that explains the change of arm space is little. It will increase when the composition difference changes from 0 to 0.1. Meantime it increases in proportional with composition difference increasing. It will decrease when the secondary arm space increases from 1.5nm to 2.7nm and from 15nm to 27nm under 40μm to 20μm at the 0.1 and 1 composition difference with. It exists in 0~0.1 and 0~1 composition difference respectively. When the secondary arm space increases from the secondary arm space difference will decrease.

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