論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Microstructure Control and Fatigue Crack Growth Behavior of Wrought γ-based TiAl Alloys Containing β-Ti Phase
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第10949号, 授与年月日:2018年9月20日, 学位の種別:課程博士, 審査員:竹山 雅夫,中村 吉男,藤居 俊之,村石 信二,小林 覚
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第10949号, Conferred date:2018/9/20, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	Metallurgy and Ceramics Science 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Engineering)
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The thesis title is "Microstructure Control and Fatigue Crack Growth Behavior of Wrought γ-based TiAl Alloys Containing β-Ti Phase". The objectives of this study are to determine the relationship between microstructure and fatigue crack growth properties of wrought TiAl alloy containing β phase. This thesis consists of 6 chapters.

The Chapter 1 is General Introduction. In this chapter, the context of the study with both the increase of the aircraft fleet and the limitation of CO_2 emissions have been described. The necessity to develop lighter materials to improve turbojet engines efficiency and the current activities, applications, and future trends on development of titanium aluminides based on γ phase to replace the nickel based alloys have been introduced. The state of the art on γ-TiAl alloy such as crystallography and microstructures have been reported. The microstructure design principal of wrought TiAl alloys for developing high toughness materials, and thus, replace not only low turbine blades but also high pressure compressor, and the importance of using the β phase have been detailed. Previous studies on the effect of microstructure and especially the β phase may affect the mechanicals properties was pointed. Finally, structure and objectives of this thesis have been outlined.

In the Chapter 2, Phase Equilibria among β-Ti/ α_2-Ti_3Al/ γ-TiAl in Ti-Al-M system**,** the phase equilibria between 1073 K and 1473 K of Ti-Al-M ternary system where M is a β-stabilizer element, here vanadium and manganese have been determined. Moreover, a reassessment above 1473 K was conducted. The effect of temperature on the movement of the β /α(α_2)/ γ three-phase triangle, revealed that below a certain temperature the direction of the triangle changes and moves toward low Al and high M contents and reveal a new transformation pathway β +α(α_2)+ γ → β+γ → β+α_2+ γ near 1073 K with the existence of two types of α phase. Moreover, the results suggest that Mn is stronger α-stabilizer than α_2-stabilizer and thus, α → β +α_2+ γ ternary eutectoid reaction occur between 1173 and 1193 K.

Chapter 3: Microstructure control of β -Ti phase in wrought alloys. In this chapter, the control of the β phase based on the phase transformations of wrought γ-TiAl alloys have been studied using the vertical section of the phase equilibria determined in Chapter 2. The competition between β decomposition, cellular reaction and coarsening allowed to design various morphologies of β associated with the γ phase surrounded the lamellar colonies. Finally, model microstructures have been design for FCG tests.

Chapter 4: Effect of microstructure on fatigue crack growth behavior of wrought alloys at ambient temperature. In this chapter, the effect of β/γ duplex (DP) structure decorating the lamellar grains boundaries have been investigated at room temperature, model alloy with different volume fraction V_{DP} and morphology were used. It has been revealed that the introduction of a certain fraction of β phase associated with γ grains in wrought TiAl alloy increase the stress intensity threshold and decrease the Paris slope compared to corresponding duplex TiAl alloy. The combination of a

deformable γ phase combined with strong but brittle β phase reduced the stress at the crack tip, and thus, improve the fatigue threshold, whereas the multiple crack due to the refinement of the microstructure allowed by the presence of the β phase at high temperature reduce the Paris slope.

Chapter 5: Effect of microstructure on fatigue crack growth behavior of wrought alloys at elevated temperatures. In this chapter, the effect of β + γ duplex (DP) structure decorating the lamellar grains boundaries have been investigated at elevated temperatures (873 and 1073 K). The increase of temperature reduces the fatigue threshold and decreases the Paris slope up to a minimum. Then, the fatigue threshold drastically increases and become higher than ambient temperature threshold whereas the Paris slope do not change. The oxidation-induced crack closure effect has been proposed to explain the rise of the fatigue threshold. At the contrary, the change in the nature of phases explain the reduction of Paris slope. Finally, oxidation-induced phase transformation of the β phase has been observed and may affect negatively the fatigue threshold.

Chapter 6: General conclusion. The conclusions obtained from each chapter are summarized. In addition, possible microstructure to achieve high fatigue crack resistance to investigate have been proposed, together with future work.