

# Contents

## Chapter 1 Introduction

1.1 Ti and Ti Alloy	
1.1.1 Crystal Structure of Titanium	1
1.1.2 Phase Diagram	1
1.1.3 Casting of Titanium	2
1.2 $Y_2O_3$ - $ZrO_2$	3
1.2.1 Phase Diagram	3
1.2.2 The $c \rightarrow t$ - $ZrO_2$ Diffusion Transformation	4
1.2.3 The $c \rightarrow t'$ - $ZrO_2$ Diffusionless Transformation	4
1.3 Ti/ $ZrO_2$ System	6
1.4 Thesis Outline	8
References	9

## Chapter 2 $Ti_2ZrO$ Phases Formed in the Titanium and Zirconia Interface after Reaction at 1550°C

2.1 Introduction	18
2.2 Experimental Procedures	19
2.3 Results and Discussion	21
2.4 Conclusions	25
References	26

## Chapter 3

### Zirconia-Related Phases in the Zirconia/Titanium Diffusion Couple after Annealing at 1100° to 1550°C

3.1 Introduction	35
3.2 Experimental Procedures	37

3.3 Results and Discussion.....	39
3.3.1 Annealing at 1100°C.....	39
3.3.2 Annealing at 1300°C.....	39
3.3.3 Annealing at 1550°C.....	40
3.3.4 Proposed model of phase development at 1300°C.....	45
3.3.4 Proposed model of phase development at 1550°C.....	46
3.4 Conclusions.....	47
References.....	47

## **Chapter 4**

### **Microstructural Evolution and Formation Mechanism of the Interface between Titanium and Zirconia Annealed at 1550°C**

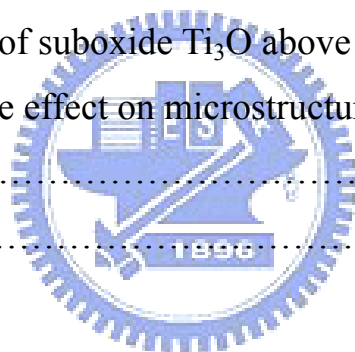
4.1 Introduction.....	59
4.2 Experimental Procedures.....	60
4.3 Results and Discussion.....	61
4.3.1 Formation Mechanism of Various Reaction Layers.....	61
4.3.2 Proposed Model of Microstructural Evolution.....	69
4.4 Conclusions.....	72
References.....	73

## **Chapter 5**

### **Temperature Dependence of the Interfacial Reaction between Titanium and Zirconia Annealed between 1100° and 1550°C**

5.1 Introduction.....	87
-----------------------	----

5.2	Experimental Procedures.....	88
5.2.1	Sample Preparation.....	88
5.2.2	Sample Observation.....	89
5.2.2.1	SEM/EDS analyses.....	89
5.2.2.2	TEM/EDS analyses.....	90
5.3	Results and Discussion.....	90
5.3.1	Distinct microstructures at various temperatures.....	90
5.3.2	Variation in the reaction layer “I”.....	92
5.3.3	Formation of the reaction layer “II” at 1550°C.....	94
5.3.4	Variation of the reaction layer “III”.....	95
5.3.5	Variation in the reaction layer “V”.....	95
5.3.6	Variation in the reaction layer “VI”.....	96
5.3.7	Formation of suboxide $Ti_3O$ above 1400°C.....	97
5.3.8	Temperature effect on microstructural development.....	100
5.4	Conclusions.....	103
	References.....	105



<b>Chapter 6</b>	<b>Summary.....</b>	<b>119</b>
6.1	Interface structures and reaction mechanisms at 1100°C. ....	119
6.2	Interface structures and reaction mechanisms at 1300°C. ....	120
6.3	Interface structures and reaction mechanisms at 1400°C. ....	120
6.4	Interface structures and reaction mechanisms at 1550°C. ....	121