

**INVESTIGATION OF THE Pt-Al-Cr SYSTEM
AS PART OF THE DEVELOPMENT OF THE Pt-Al-Cr-Ru
THERMODYNAMIC DATABASE**

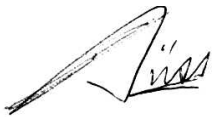
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A thesis submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Doctor of Philosophy.

Johannesburg 2007.

DECLARATION

I, Rainer Süß, declare that this thesis is my own work except where otherwise acknowledged. It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted previously at this, or any other university for any degree or examination.



SIGNATURE

15/1/2008

DATE

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Now it's your turn....

"One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of this mystery every day."

—Albert Einstein - From the memoirs of William Miller, an editor, quoted in *Life* magazine, May 2, 1955.

ABSTRACT

The ternary Pt-Al-Cr system was investigated as part of the continued development of a thermodynamic database for the Pt-Al-Cr-Ru system. Scanning electron microscopy with energy dispersive X-ray spectroscopy and X-ray diffraction analyses were used to obtain phase equilibria data. The alloys were studied in the as-cast condition, as well as after annealing at 600°C and 1000°C respectively. A solidification projection was constructed and a liquidus surface derived. Isothermal sections at 600°C and 1000°C were also determined. It was concluded that all phase regions were identified correctly since the results were self-consistent. Three ternary phases were found and 19 ternary invariant reactions identified.

A thermodynamic database was developed for the Pt-Al-Cr system using Thermo-Calc. Phase relations could be reasonably accurately predicted between 600°C and 1000°C, and even up to temperatures close to the melting point. However, the match between the calculated and experimental diagrams could be improved. As with the Pt-Cr-Ru system, problems with the constituting binary systems seemed to be the major cause for problems encountered in the modelling. Only once the Al-Pt and especially the Cr-Pt and Cr-Ru binary phase diagrams are confirmed more rigorously, the calculated ternary phase diagrams could be worked on with more confidence.

More than half of the alloys investigated had hardnesses in excess of 600 HV₁₀ regardless of their state of heat treatment. Based on the examination of hardness indentations, alloys in the Pt-Al-Cr system were also often brittle due to the presence of hard intermetallic compounds. Alloys containing ~Pt₃Al showed better behaviour with regard to toughness which was encouraging for the Pt-based alloys that are being developed by Mintek.

TABLE OF CONTENTS

PART ONE: INTRODUCTION, BACKGROUND AND LITERATURE REVIEW	1
1. INTRODUCTION AND BACKGROUND.....	1
2. LITERATURE REVIEW.....	4
2.1. The binary Cr-Pt phase diagram	4
2.2. The binary Pt-Al phase diagram	10
2.3. The binary Al-Cr phase diagram	17
2.4. The ternary Pt-Al-Cr system.....	25
PART TWO: PHASE ANALYSES OF THE Pt-Al-Cr SYSTEM.....	27
1. EXPERIMENTAL PROCEDURE	27
2. RESULTS AND DISCUSSION.....	28
2.1. Phase analysis – as cast	28
2.1.1. Nominal Pt ₁₀ :Al ₁₀ :Cr ₈₀	28
2.1.2. Nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀	30
2.1.3. Nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀	33
2.1.4. Nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀	36
2.1.5. Nominal Pt ₂₀ :Al ₂₀ :Cr ₆₀	39
2.1.6. Nominal Pt ₂₀ :Al ₄₀ :Cr ₄₀	42
2.1.7. Nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀	45
2.1.8. Nominal Pt ₄₀ :Al ₁₀ :Cr ₅₀	49
2.1.9. Nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀	53
2.1.10. Nominal Pt ₄₀ :Al ₅₀ :Cr ₁₀	60
2.1.11. Nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀	63
2.1.12. Nominal Pt ₆₅ :Al ₅ :Cr ₃₀	67
2.1.13. Nominal Pt ₃ :Al ₆₅ :Cr ₃₂	69
2.1.14. Nominal Pt ₃ :Al ₃₅ :Cr ₆₂	73
2.1.15. Nominal Pt ₁₀ :Al ₅₀ :Cr ₄₀	78
2.1.16. Nominal Pt ₁₂ :Al ₁₈ :Cr ₇₀	82
2.1.17. Nominal Pt ₁₇ :Al ₆₈ :Cr ₁₅	86
2.1.18. Nominal Pt ₁₈ :Al ₂ :Cr ₈₀	89
2.1.19. Nominal Pt ₂₈ :Al ₁₂ :Cr ₆₀	91
2.1.20. Nominal Pt ₂₈ :Al ₇₀ :Cr ₂	95
2.1.21. Nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀	98
2.1.22. Nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀	102
2.1.23. Nominal Pt ₄₃ :Al ₅₂ :Cr ₅	105
2.1.24. Nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅	108
2.1.25. Nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂	111
2.1.26. Nominal Pt ₆₀ :Al ₂ :Cr ₃₈	114
2.1.27. Nominal Pt ₆₃ :Al ₃₂ :Cr ₅	117
2.1.28. Nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅	120
2.1.29. Nominal Pt ₇₈ :Al ₁₇ :Cr ₅	123
2.1.30. Nominal Pt ₇₅ :Al ₁₀ :Cr ₁₅	126
2.1.31. Nominal Pt ₃ :Al ₇₉ :Cr ₁₈	130
2.1.32. Nominal Pt ₅ :Al ₅₂ :Cr ₄₃	134
2.1.33. Nominal Pt ₁₃ :Al ₄₅ :Cr ₄₂	137
2.1.34. Nominal Pt ₁₅ :Al ₅ :Cr ₈₀	140
2.1.35. Nominal Pt ₃₄ :Al ₂₇ :Cr ₃₉	143

2.1.36.	Nominal Pt ₃₇ :Al ₅₉ :Cr ₄	147
2.1.37.	Nominal Pt ₄₅ :Al ₃₅ :Cr ₂₀	149
2.1.38.	Nominal Pt ₅₂ :Al ₄₃ :Cr ₅	152
2.1.39.	Nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀	155
2.1.40.	Nominal Pt ₅₅ :Al ₂₀ :Cr ₂₅	158
2.1.41.	Nominal Pt ₆₄ :Al ₁₆ :Cr ₂₀	162
2.1.42.	Nominal Pt ₈ :Al ₈₉ :Cr ₃	165
2.1.43.	Nominal Pt ₄ :Al ₈₃ :Cr ₁₃	168
2.1.44.	Solidification projection	170
2.1.45	Liquidus surface projection	173
2.2.	Phase analysis – annealed at 1000°C for 1000 hours	181
2.2.1	Nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀	181
2.2.2	Nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀	185
2.2.3	Nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀	188
2.2.4	Nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀	192
2.2.5	Nominal Pt ₆₅ :Al ₅ :Cr ₃₀	195
2.2.6	Nominal Pt ₃ :Al ₆₅ :Cr ₃₂	198
2.2.7	Nominal Pt ₃ :Al ₃₅ :Cr ₆₂	199
2.2.8	Nominal Pt ₁₈ :Al ₂ :Cr ₈₀	201
2.2.9	Nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀	205
2.2.10	Nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀	209
2.2.11	Nominal Pt ₄₃ :Al ₅₂ :Cr ₅	212
2.2.12	Nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅	213
2.2.13	Nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂	217
2.2.14	Nominal Pt ₆₃ :Al ₃₂ :Cr ₅	220
2.2.15	Nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅	223
2.2.16	Nominal Pt ₇₅ :Al ₁₀ :Cr ₁₅	226
2.2.17	Nominal Pt ₁₅ :Al ₅ :Cr ₈₀	228
2.2.18	Nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀	231
2.2.19	1000°C Isothermal Section.....	235
2.3.	PHASE ANALYSIS – ANNEALED AT 600°C FOR 2500 HOURS	238
2.3.1	Nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀	238
2.3.2	Nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀	242
2.3.3	Nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀	245
2.3.4	Nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀	249
2.3.5	Nominal Pt ₆₅ :Al ₅ :Cr ₃₀	252
2.3.6	Nominal Pt ₃ :Al ₆₅ :Cr ₃₂	255
2.3.7	Nominal Pt ₃ :Al ₃₅ :Cr ₆₂	258
2.3.8	Nominal Pt ₁₈ :Al ₂ :Cr ₈₀	262
2.3.9	Nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀	265
2.3.10	Nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀	267
2.3.11	Nominal Pt ₄₃ :Al ₅₂ :Cr ₅	271
2.3.12	Nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅	272
2.3.13	Nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂	276
2.3.14	Nominal Pt ₆₃ :Al ₃₂ :Cr ₅	279
2.3.15	Nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅	282
2.3.16	Nominal Pt ₇₅ :Al ₁₀ :Cr ₁₅ (Actual Pt ₃₃ :Al ₅₁ :Cr ₁₆).....	285
2.3.17	Nominal Pt ₁₅ :Al ₅ :Cr ₈₀	289
2.3.18	Nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀	291
2.3.19	600°C isothermal section.....	294

3.CONCLUSIONS.....	296
PART THREE: THERMODYNAMIC MODELLING IN THE Pt-Al-Cr SYSTEM USING THERMO-CALC	298
1. AN INTRODUCTION TO CALPHAD	298
2. AN INTRODUCTION TO THERMO-CALC	300
3. MOTIVATION FOR THE DEVELOPMENT OF A THERMODYNAMIC DATABASE FOR Pt-CONTAINING ALLOYS.....	301
4. BUILDING THE DATABASE	302
4.1 Pt-Al.....	305
4.2 Al-Cr	308
4.3 Cr-Pt	309
4.4 Pt-Al-Cr	313
4.4.1 Extrapolation.....	313
4.4.2 The addition of ternary phase T1	316
4.4.3 Optimisation: The evolution of the model parameters	321
5. COMPARISON OF EXPERIMENTAL AND CALCULATED RESULTS.....	334
6. CONCLUSIONS AND RECOMMENDATIONS	345
PART FOUR: SELECTED MECHANICAL PROPERTIES.....	347
1. HARDNESS	347
1.1. Experimental procedure.....	347
1.2. Results and discussion	347
1.2.1. As-cast	347
1.2.2. Annealed at 1000°C.....	349
1.2.3. Annealed at 600°C.....	352
1.3. Conclusions	353
2. TOUGHNESS	354
2.1. Experimental procedure.....	354
2.2. Results and discussion	354
2.2.1. As-cast	354
2.2.2. Annealed at 1000°C.....	362
2.2.3. Annealed at 600°C.....	367
2.3. Conclusions	371
PART FIVE: GENERAL CONCLUSIONS.....	372
REFERENCES.....	374
APPENDICES	383
Appendix A - Papers published during the course of the research work.....	384
Appendix B - Thermo-Calc database for Pt-Al-Cr (TDB-format)	

LIST OF FIGURES

Figure 1.1. Binary Cr-Pt equilibrium phase diagram [1990Mas].	7
Figure 1.2. Proposed refinement by Zhao et al. [2005Zhao] (dotted lines) of the Cr-Pt phase diagram.	8
Figure 1.3. Calculated binary Cr-Pt equilibrium phase diagram [2001Oik].	9
Figure 1.4. Calculated binary Cr-Pt equilibrium phase diagram [2003Gla].	9
Figure 1.5. Binary Al-Pt equilibrium phase diagram [1990Mas].	11
Figure 1.6. Binary Al-Pt equilibrium phase diagram [1987Oya].	15
Figure 1.7. Calculated binary Al-Pt equilibrium phase diagram [2002Pri1].	16
Figure 1.8. Binary Al-Cr equilibrium phase diagram [1990Mas].	21
Figure 1.9. Calculated binary phase diagram of Al-Cr [2001Dup].	24
Figure 1.10. Partial isothermal section of the Pt-Al-Cr system at 1350)°C [2001Hil4].	26
Figure 2.1. BSE-SEM image of nominal Pt ₁₀ :Al ₁₀ :Cr ₈₀ in the as-cast condition: (Cr) dark; ~PtAl light.	29
Figure 2.2. EDX analyses of nominal Pt ₁₀ :Al ₁₀ :Cr ₈₀ (at.%) in the as-cast condition.	29
Figure 2.3. BSE-SEM image of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ in the as-cast condition: (Cr) dark; ~PtAl ₂ light; ~Cr ₂ Al grey?	30
Figure 2.4. EDX analyses of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) in the as-cast condition.	31
Figure 2.5. XRD pattern for nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ in the as-cast condition.	32
Figure 2.6. BSE-SEM image of nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ in the as-cast condition: ~Cr ₅ Al ₈ dark; ~PtAl ₂ light.	33
Figure 2.7. EDX analyses of nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ (at.%) in the as-cast condition.	34
Figure 2.8. XRD pattern for nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ in the as-cast condition.	35
Figure 2.9. BSE-SEM image of nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ in the as-cast condition: (Al) very dark; ~CrAl ₅ dark; ~Pt ₈ Al ₂₁ light; ~PtAl ₂ very light.	37
Figure 2.10. EDX analyses of nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ (at.%) in the as-cast condition.	37
Figure 2.11. XRD pattern for nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ in the as-cast condition.	38
Figure 2.12. BSE-SEM image of nominal Pt ₂₀ :Al ₂₀ :Cr ₆₀ in the as-cast condition: (Cr) dark; light ~PtAl.	39
Figure 2.13. EDX analyses of nominal Pt ₂₀ :Al ₂₀ :Cr ₆₀ (at.%) in the as-cast condition.	40
Figure 2.14. XRD pattern for nominal Pt ₂₀ :Al ₂₀ :Cr ₆₀ in the as-cast condition.	41
Figure 2.15. BSE-SEM image of nominal Pt ₂₀ :Al ₄₀ :Cr ₄₀ in the as-cast condition: (Cr) dark; ~PtAl ₂ light + ~PtAl light.	42
Figure 2.16. EDX analyses of nominal Pt ₂₀ :Al ₄₀ :Cr ₄₀ (at.%) in the as-cast condition.	43
Figure 2.17. XRD pattern for nominal Pt ₂₀ :Al ₄₀ :Cr ₄₀ in the as-cast condition.	44
Figure 2.18. EDX analyses of nominal Pt ₂₀ :Al ₄₀ :Cr ₄₀ (at.%) in the as-cast condition with suggested extrapolations.	45
Figure 2.19. BSE-SEM image of nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ in the as-cast condition: (Cr) black; ~PtAl ₂ grey; ~PtAl white.	46
Figure 2.20. EDX analyses of nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ (at.%) in the as-cast condition.	47
Figure 2.21. XRD pattern for nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ in the as-cast condition.	48
Figure 2.22. BSE-SEM image of nominal Pt ₄₀ :Al ₁₀ :Cr ₅₀ in the as-cast condition: ~CrPt dark; ~Pt ₂ Al light.	50
Figure 2.23. EDX analyses of nominal Pt ₄₀ :Al ₁₀ :Cr ₅₀ (at.%) in the as-cast condition.	50
Figure 2.24. XRD pattern for nominal Pt ₄₀ :Al ₁₀ :Cr ₅₀ in the as-cast condition.	51
Figure 2.25. XRD pattern for nominal Pt ₄₀ :Al ₁₀ :Cr ₅₀ , Pt ₅₀ :Al ₁₀ :Cr ₄₀ , Pt ₅₅ :Al ₂₅ :Cr ₂₀ , Pt ₅₅ :Al ₂₀ :Cr ₂₅ , in the as-cast condition.	52

Figure 2.26. BSE-SEM image of nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ in the as-cast condition: Cored T1.	54
Figure 2.27. EDX analyses of nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ (at.%) in the as-cast condition.	54
Figure 2.28. XRD pattern for nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ in the as-cast condition.	55
Figure 2.29. XRD pattern for nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ , Pt ₅₀ :Al ₃₅ :Cr ₁₅ , Pt ₄₅ :Al ₃₅ :Cr ₂₀ and Pt ₅₂ :Al ₄₃ :Cr ₅ (bottom to top) in the as-cast condition.	56
Figure 2.1. XRD pattern for nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ , Pt ₅₀ :Al ₃₅ :Cr ₁₅ , Pt ₄₅ :Al ₃₅ :Cr ₂₀ and Pt ₅₂ :Al ₄₃ :Cr ₅ in the as-cast condition compared to that of Pt ₂ Al as modelled by Crystallographica.	57
Figure 2.31. The average peak positions of ternary T1 as inferred from the shown measured XRD patterns for nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ , Pt ₅₀ :Al ₃₅ :Cr ₁₅ , Pt ₄₅ :Al ₃₅ :Cr ₂₀ and Pt ₅₂ :Al ₄₃ :Cr ₅ in the as-cast condition.	58
Figure 2.32. The average peak positions of ternary T1 superimposed on the measured XRD patterns for nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ in the as-cast condition.	59
Figure 2.33. BSE-SEM image of nominal Pt ₄₀ :Al ₅₀ :Cr ₁₀ in the as-cast condition: ~Pt ₂ Al ₃ dark; ~PtAl lighter.	61
Figure 2.34. EDX analyses of nominal Pt ₄₀ :Al ₅₀ :Cr ₁₀ (at.%) in the as-cast condition.	61
Figure 2.35. XRD pattern for nominal Pt ₄₀ :Al ₅₀ :Cr ₁₀ in the as-cast condition.	62
Figure 2.36. BSE-SEM image of nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ in the as-cast condition: ~CrPt dark; ~Pt ₂ Al light.	63
Figure 2.37. EDX analyses of nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ (at.%) in the as-cast condition.	64
Figure 2.38. XRD patterns for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ and Pt ₄₀ :Al ₁₀ :Cr ₅₀ in the as-cast condition.	65
Figure 2.39. XRD pattern for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ in the as-cast condition.	66
Figure 2.40. BSE-SEM image of nominal Pt ₆₅ :Al ₅ :Cr ₃₀ in the as-cast condition: ~Pt ₃ Cr medium and light; ~Pt ₃ Al dark.	67
Figure 2.41. XRD pattern for nominal Pt ₆₅ :Al ₅ :Cr ₃₀ in the as-cast condition.	68
Figure 2.42. EDX analyses of nominal Pt ₆₅ :Al ₅ :Cr ₃₀ (at.%) in the as-cast condition.	69
Figure 2.43. BSE-SEM image of nominal Pt ₃ :Al ₆₅ :Cr ₃₂ in the as-cast condition: ~Cr ₄ Al ₉ dark; ~PtAl ₂ light.	70
Figure 2.44. EDX analyses of nominal Pt ₃ :Al ₆₅ :Cr ₃₂ (at.%) in the as-cast condition.	71
Figure 2.45. XRD pattern for nominal Pt ₃ :Al ₆₅ :Cr ₃₂ in the as-cast condition.	72
Figure 2.46. BSE-SEM image of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ in the as-cast condition: ~Cr ₂ Al black; ~PtAl ₂ white; T ₂ ≈Cr ₃ Al ₂ grey.	74
Figure 2.47. EDX analyses of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) in the as-cast condition.	75
Figure 2.48. EDX analyses of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) in the as-cast condition.	76
Figure 2.49. XRD pattern for nominal Pt ₃ :Al ₃₅ :Cr ₆₂ in the as-cast condition.	77
Figure 2.50. BSE-SEM image of nominal Pt ₁₀ :Al ₅₀ :Cr ₄₀ in the as-cast condition: T ₂ ≈Cr ₃ Al ₂ dark; ~PtAl ₂ light.	79
Figure 2.51. EDX analyses of nominal Pt ₁₀ :Al ₅₀ :Cr ₄₀ (at.%) in the as-cast condition.	80
Figure 2.52. XRD pattern for nominal Pt ₁₀ :Al ₅₀ :Cr ₄₀ in the as-cast condition.	81
Figure 2.53. BSE-SEM image of nominal Pt ₁₂ :Al ₁₈ :Cr ₇₀ in the as-cast condition: (Cr) black; PtAl ₂ grey; ~PtAl light.	83
Figure 2.54. EDX analyses of nominal Pt ₁₂ :Al ₁₈ :Cr ₇₀ (at.%) in the as-cast condition.	84
Figure 2.55. Extrapolation of inaccurate phase compositions of nominal Pt ₁₂ :Al ₁₈ :Cr ₇₀ (at.%) in the as-cast condition to more probable compositions.	84
Figure 2.56. XRD pattern for nominal Pt ₁₂ :Al ₁₈ :Cr ₇₀ in the as-cast condition.	85
Figure 2.57. BSE-SEM image of nominal Pt ₁₇ :Al ₆₈ :Cr ₁₅ in the as-cast condition: ~Cr ₄ Al ₉ black; ~CrAl ₄ grey; ~PtAl ₂ white.	86
Figure 2.58. EDX analyses of nominal Pt ₁₇ :Al ₆₈ :Cr ₁₅ (at.%) in the as-cast condition.	87
Figure 2.59. XRD pattern for nominal Pt ₁₇ :Al ₆₈ :Cr ₁₅ in the as-cast condition.	88

Figure 2.60. BSE-SEM image of nominal Pt ₁₈ :Al ₂ :Cr ₈₀ in the as-cast condition: (Cr) dark; ~Cr ₃ Pt medium; ~CrPt light.	89
Figure 2.61. XRD pattern for nominal Pt ₁₈ :Al ₂ :Cr ₈₀ in the as-cast condition.	90
Figure 2.62. EDX analyses of nominal Pt ₁₈ :Al ₂ :Cr ₈₀ (at.%) in the as-cast condition.	91
Figure 2.63. BSE-SEM image of nominal Pt ₂₈ :Al ₁₂ :Cr ₆₀ in the as-cast condition: (Cr) black; ~CrPt grey; T1 white.	92
Figure 2.64. EDX analyses of nominal Pt ₂₈ :Al ₁₂ :Cr ₆₀ (at.%) in the as-cast condition with directions of possible extrapolation indicated.	93
Figure 2.65. XRD pattern for nominal Pt ₂₈ :Al ₁₂ :Cr ₆₀ in the as-cast condition.	94
Figure 2.66. BSE-SEM image of nominal Pt ₂₈ :Al ₇₀ :Cr ₂ in the as-cast condition: ~PtAl ₂ light; ~Pt ₈ Al ₂₁ dark; porosity black.	95
Figure 2.67. EDX analyses of nominal Pt ₂₈ :Al ₇₀ :Cr ₂ (at.%) in the as-cast condition.	96
Figure 2.68. XRD pattern for nominal Pt ₂₈ :Al ₇₀ :Cr ₂ in the as-cast condition.	97
Figure 2.69. BSE-SEM image of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ in the as-cast condition: ~PtAl ₂ + ~PtAl light; ~PtAl ₂ dark.	99
Figure 2.70. EDX analyses of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) in the as-cast condition.	99
Figure 2.71. EDX analyses of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) in the as-cast condition.	100
Figure 2.72. XRD pattern for nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ in the as-cast condition.	101
Figure 2.73. BSE-SEM image of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ in the as-cast condition: ~CrPt dark; T1 light.	102
Figure 2.74. EDX analyses of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) in the as-cast condition.	103
Figure 2.75. XRD pattern for nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ in the as-cast condition.	104
Figure 2.76. BSE-SEM image of nominal Pt ₄₃ :Al ₅₂ :Cr ₅ in the as-cast condition: ~Pt ₂ Al ₃ dark; ~PtAl light.	105
Figure 2.77. EDX analyses of nominal Pt ₄₃ :Al ₅₂ :Cr ₅ (at.%) in the as-cast condition.	106
Figure 2.78. XRD pattern for nominal Pt ₄₃ :Al ₅₂ :Cr ₅ in the as-cast condition.	107
Figure 2.79. BSE-SEM image of nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ in the as-cast condition: cored T1.	108
Figure 2.80. EDX analyses of nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ (at.%) in the as-cast condition.	109
Figure 2.81. XRD pattern for nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ in the as-cast condition.	110
Figure 2.82. BSE-SEM image of nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ in the as-cast condition: ~CrPt dark; ~Pt ₃ Al light; very dark oxides.	111
Figure 2.83. EDX analyses of nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ (at.%) in the as-cast condition.	112
Figure 2.84. XRD pattern for nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ in the as-cast condition.	113
Figure 2.85. BSE-SEM image of nominal Pt ₆₀ :Al ₂ :Cr ₃₈ in the as-cast condition: cored ~CrPt.	114
Figure 2.86. EDX analyses of nominal Pt ₆₀ :Al ₂ :Cr ₃₈ (at.%) in the as-cast condition.	115
Figure 2.87. XRD pattern for nominal Pt ₆₀ :Al ₂ :Cr ₃₈ in the as-cast condition.	116
Figure 2.88. BSE-SEM image of nominal Pt ₆₃ :Al ₃₂ :Cr ₅ in the as-cast condition: ~T1 very dark; ~Pt ₂ Al dark and light.	117
Figure 2.89. EDX analyses of nominal Pt ₆₃ :Al ₃₂ :Cr ₅ (at.%) in the as-cast condition.	118
Figure 2.90. XRD pattern for nominal Pt ₆₃ :Al ₃₂ :Cr ₅ in the as-cast condition.	119
Figure 2.91. BSE-SEM image of nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ in the as-cast condition: cored ~Pt ₃ Al grey; contamination white.	120
Figure 2.92. EDX analyses of nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ (at.%) in the as-cast condition.	121
Figure 2.93. XRD pattern for nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ in the as-cast condition.	122
Figure 2.94. BSE-SEM image of nominal Pt ₇₈ :Al ₁₇ :Cr ₅ in the as-cast condition: (Pt) light; ~Pt ₃ Al + (Pt) dark.	123
Figure 2.95. EDX analyses of nominal Pt ₇₈ :Al ₁₇ :Cr ₅ (at.%) in the as-cast condition.	124
Figure 2.96. XRD pattern for nominal Pt ₇₈ :Al ₁₇ :Cr ₅ in the as-cast condition.	125

Figure 2.97. BSE-SEM image of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ in the as-cast condition: ~PtAl ₂ dark; ~PtAl ₂ grey; ~PtAl light; (Cr), porosity black.	127
Figure 2.98. EDX analyses of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ (at.%) in the as-cast condition.	127
Figure 2.99. Extrapolation of phase compositions of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ (at.%) in the as-cast condition.	128
Figure 2.100. XRD pattern for nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ in the as-cast condition.	129
Figure 2.101. BSE-SEM image of nominal Pt ₃ :Al ₇₉ :Cr ₁₈ in the as-cast condition: T ₃ ~CrAl ₃ dark; ~CrAl ₄ medium; ~CrAl ₅ light; porosity black; white Pt ₈ Al ₂₁	131
Figure 2.102. EDX analyses of nominal Pt ₃ :Al ₇₉ :Cr ₁₈ (at.%) in the as-cast condition.	132
Figure 2.103. XRD pattern for nominal Pt ₃ :Al ₇₉ :Cr ₁₈ in the as-cast condition.	133
Figure 2.104. BSE-SEM image of nominal Pt ₅ :Al ₅₂ :Cr ₄₃ in the as-cast condition: ~Cr ₅ Al ₈ dark; T ₂ ~Cr ₃ Al ₂ medium; ~PtAl ₂ light.	134
Figure 2.105. EDX analyses of nominal Pt ₅ :Al ₅₂ :Cr ₄₃ (at.%) in the as-cast condition.	135
Figure 2.106. XRD pattern for nominal Pt ₅ :Al ₅₂ :Cr ₄₃ in the as-cast condition.	136
Figure 2.107. BSE-SEM image of nominal Pt ₁₃ :Al ₄₅ :Cr ₄₂ in the as-cast condition: ~Cr ₂ Al dark; ~PtAl ₂ light.	137
Figure 2.108. EDX analyses of nominal Pt ₁₃ :Al ₄₅ :Cr ₄₂ (at.%) in the as-cast condition.	138
Figure 2.109. XRD pattern for nominal Pt ₁₃ :Al ₄₅ :Cr ₄₂ in the as-cast condition.	139
Figure 2.110. BSE-SEM image of nominal Pt ₁₅ :Al ₅ :Cr ₈₀ in the as-cast condition: (Cr) black; ~CrPt grey; T ₁ white.	140
Figure 2.111. EDX analyses of nominal Pt ₁₅ :Al ₅ :Cr ₈₀ (at.%) in the as-cast condition.	141
Figure 2.112. XRD pattern for nominal Pt ₁₅ :Al ₅ :Cr ₈₀ in the as-cast condition.	142
Figure 2.113. BSE-SEM image of nominal Pt ₃₄ :Al ₂₇ :Cr ₃₉ in the as-cast condition: (Cr) dark; T ₁ light; porosity black; sparse eutectic encircled areas.	144
Figure 2.114. EDX analyses of nominal Pt ₃₄ :Al ₂₇ :Cr ₃₉ (at.%) in the as-cast condition.	145
Figure 2.115. XRD pattern for nominal Pt ₃₄ :Al ₂₇ :Cr ₃₉ in the as-cast condition.	146
Figure 2.116. BSE-SEM image of nominal Pt ₃₇ :Al ₅₉ :Cr ₄ in the as-cast condition: cored ~Pt ₂ Al ₃	147
Figure 2.117. EDX analyses of nominal Pt ₃₇ :Al ₅₉ :Cr ₄ (at.%) in the as-cast condition.	148
Figure 2.118. BSE-SEM image of nominal Pt ₄₅ :Al ₃₅ :Cr ₂₀ in the as-cast condition: grey T ₁	149
Figure 2.119. EDX analyses of nominal Pt ₄₅ :Al ₃₅ :Cr ₂₀ (at.%) in the as-cast condition.	150
Figure 2.120. XRD pattern for nominal Pt ₄₅ :Al ₃₅ :Cr ₂₀ in the as-cast condition.	151
Figure 2.121. BSE-SEM image of nominal Pt ₅₂ :Al ₄₃ :Cr ₅ in the as-cast condition: grey T ₁	152
Figure 2.122. EDX analyses of nominal Pt ₅₂ :Al ₄₃ :Cr ₅ (at.%) in the as-cast condition.	153
Figure 2.123. XRD pattern for nominal Pt ₅₂ :Al ₄₃ :Cr ₅ in the as-cast condition.	154
Figure 2.124. BSE-SEM image of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ in the as-cast condition: ~Pt ₂ Al dark; T ₁ light.	155
Figure 2.125. EDX analyses of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) in the as-cast condition.	156
Figure 2.126. XRD pattern for nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ in the as-cast condition.	157
Figure 2.127. BSE-SEM image of nominal Pt ₅₅ :Al ₂₀ :Cr ₂₅ in the as-cast condition: ~Pt ₃ Al dark; ~Pt ₂ Al; porosity black.	158
Figure 2.128. EDX analyses of nominal Pt ₅₅ :Al ₂₀ :Cr ₂₅ (at.%) in the as-cast condition.	159
Figure 2.129. XRD patterns for nominal Pt ₅₅ :Al ₂₀ :Cr ₂₅ and Pt ₅₅ :Al ₂₅ :Cr ₂₀ in the as-cast condition.	160
Figure 2.130. XRD patterns for nominal Pt ₅₅ :Al ₂₀ :Cr ₂₅ in the as-cast condition.	161
Figure 2.131. BSE-SEM image of nominal Pt ₆₄ :Al ₁₆ :Cr ₂₀ in the as-cast condition: ~Pt ₃ Cr dark; ~Pt ₃ Al light.	162
Figure 2.132. EDX analyses of nominal Pt ₆₄ :Al ₁₆ :Cr ₂₀ (at.%) in the as-cast condition.	163
Figure 2.133. XRD patterns for nominal Pt ₆₄ :Al ₁₆ :Cr ₂₀ in the as-cast condition.	164

Figure 2.134. BSE-SEM image of nominal Pt ₈ :Al ₈₉ :Cr ₃ in the as-cast condition: (Al) black; ~Cr ₂ Al ₁₃ medium; ~Pt ₈ Al ₂₁ light; ~PtAl ₂ very light (arrows).....	166
Figure 2.135. EDX analyses of nominal Pt ₈ :Al ₈₉ :Cr ₃ (at.%) in the as-cast condition.	167
Figure 2.136. BSE-SEM image of nominal Pt ₄ :Al ₈₃ :Cr ₁₃ in the as-cast condition: (Al) black (1); ~CrAl ₄ very dark and dark (2); ~Cr ₂ Al ₁₃ light (3); ~Pt ₈ Al ₂₁ white (4).	169
Figure 2.137. EDX analyses of nominal Pt ₄ :Al ₈₃ :Cr ₁₃ (at.%) in the as-cast condition.	170
Figure 2.138. Solidification projection diagram for Pt-Cr-Al.	172
Figure 2.139. Alloy Numbers of samples characterised in the Pt-Al-Cr system.....	173
Figure 2.140. Experimental liquidus surface projection for the Pt-Al-Cr system	177
Figure 2.141. BSE-SEM image of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ after annealing at 1000°C: (Cr) dark; ~PtAl ₂ white; ~Cr ₂ Al light precipitates.....	182
Figure 2.142. EDX analyses of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) after annealing at 1000°C.	183
Figure 2.143. EDX analyses of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) after annealing at 1000°C.	183
Figure 2.144. XRD pattern for nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ after annealing at 1000°C.	184
Figure 2.145. BSE-SEM image of nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ after annealing at 1000°C: (Al) black and dark grey; T1~CrAl ₅ light grey; ~PtAl ₂ white.....	185
Figure 2.146. EDX analyses of nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ (at.%) after annealing at 1000°C.	186
Figure 2.147. XRD pattern for nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ after annealing at 1000°C.....	187
Figure 2.148. BSE-SEM image of nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ after annealing at 1000°C: (Cr) black; ~PtAl ₂ grey; ~ Pt ₂ Al ₃ white.	189
Figure 2.149. EDX analyses of nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ (at.%) after annealing at 1000°C.	190
Figure 2.150. XRD pattern for nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ after annealing at 1000°C.	191
Figure 2.151. BSE-SEM image of nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ after annealing at 1000°C: ~CrPt grey.	192
Figure 2.152. EDX analyses of nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ (at.%) after annealing at 1000°C.	193
Figure 2.153. XRD patterns for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ . after annealing at 1000°C.....	194
Figure 2.154. BSE-SEM image of nominal Pt ₆₅ :Al ₅ :Cr ₃₀ after annealing at 1000°C: ~Pt ₃ Al grey.	195
Figure 2.155. EDX analyses of nominal Pt ₆₅ :Al ₅ :Cr ₃₀ (at.%) after annealing at 1000°C.	196
Figure 2.156. XRD patterns for nominal Pt ₆₅ :Al ₅ :Cr ₃₀ . after annealing at 1000°C.	197
Figure 2.157. BSE-SEM image of nominal Pt ₃ :Al ₆₅ :Cr ₃₂ after annealing at 1000°C: ~Cr ₄ Al ₉ dark; ~PtAl ₂ light.....	198
Figure 2.158. EDX analyses of nominal Pt ₃ :Al ₆₅ :Cr ₃₂ (at.%) after annealing at 1000°C.	199
Figure 2.159. BSE-SEM image of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ after annealing at 1000°C: (Cr) dark; ~PtAl ₂ light; ~Cr ₂ Al? grey.	200
Figure 2.160. EDX analyses of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) after annealing at 1000°C.	200
Figure 2.161. BSE-SEM image of nominal Pt ₁₈ :Al ₂ :Cr ₈₀ after annealing at 1000°C: (Cr) black; ~Cr ₃ Pt grey; ~CrPt white.	202
Figure 2.162. EDX analyses of nominal Pt ₁₈ :Al ₂ :Cr ₈₀ (at.%) after annealing at 1000°C.	203
Figure 2.163. XRD pattern for nominal Pt ₁₈ :Al ₂ :Cr ₈₀ after annealing at 1000°C.....	204
Figure 2.164. BSE-SEM image of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ after annealing at 1000°C: (Cr) black; ~PtAl ₂ grey; T3~Pt ₂ Al ₃ light	206
Figure 2.165. EDX analyses of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) after annealing at 1000°C.	207
Figure 2.166. XRD pattern for nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ after annealing at 1000°C.	208
Figure 2.167. BSE-SEM image of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ after annealing at 1000°C: (Cr) black; ~Cr ₃ Pt dark; T2 light.	209
Figure 2.168. EDX analyses of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) after annealing at 1000°C.	210
Figure 2.169. XRD pattern for nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ after annealing at 1000°C.	211

Figure 2.170. BSE-SEM image of nominal Pt ₄₃ :Al ₅₂ :Cr ₅ after annealing at 1000°C: Pores/Cr black; T3≈ Pt ₂ Al ₃ dark; ~PtAl light.....	212
Figure 2.171. EDX analyses of nominal Pt ₄₃ :Al ₅₂ :Cr ₅ (at.%) after annealing at 1000°C.	213
Figure 2.172. BSE-SEM image of nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ after annealing at 1000°C: ~Pt ₂ Al dark; ~PtAl light.	214
Figure 2.173. EDX analyses of nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ (at.%) after annealing at 1000°C.	215
Figure 2.174. XRD pattern for nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ after annealing at 1000°C.	216
Figure 2.175. BSE-SEM image of nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ after annealing at 1000°C: ~CrPt dark; ~Pt ₃ Al light; black porosity.	217
Figure 2.176. EDX analyses of nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ at.%) after annealing at 1000°C.	218
Figure 2.177. XRD pattern for nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ after annealing at 1000°C.	219
Figure 2.178. BSE-SEM image of nominal Pt ₆₃ :Al ₃₂ :Cr ₅ after annealing at 1000°C: ~Pt ₂ Al grey.	220
Figure 2.179. EDX analyses of nominal Pt ₆₃ :Al ₃₂ :Cr ₅ (at.%) after annealing at 1000°C.	221
Figure 2.180. XRD pattern for nominal Pt ₆₃ :Al ₃₂ :Cr ₅ after annealing at 1000°C.....	222
Figure 2.181. BSE-SEM image of nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ after annealing at 1000°C: ~Pt ₂ Al light ~Pt ₃ Al dark.	223
Figure 2.182. EDX analyses of nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ (at.%) after annealing at 1000°C.	224
Figure 2.183. XRD pattern for nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ after annealing at 1000°C.	225
Figure 2.184. BSE-SEM image of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ after annealing at 1000°C: (Cr) black; ~PtAl ₂ light; ~PtAl white.....	226
Figure 2.185. EDX analyses of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ (at.%) after annealing at 1000°C.	227
Figure 2.186. BSE-SEM image of nominal Pt ₁₅ :Al ₅ :Cr ₈₀ after annealing at 1000°C: (Cr) black; ~Cr ₃ Pt grey; ~PtAl white.....	228
Figure 2.187. EDX analyses of nominal Pt ₁₅ :Al ₅ :Cr ₈₀ (at.%) after annealing at 1000°C.	229
Figure 2.188. XRD pattern for nominal Pt ₁₅ :Al ₅ :Cr ₈₀ after annealing at 1000°C.....	230
Figure 2.189. BSE-SEM image of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ after annealing at 1000°C: (T2 + ~Pt ₃ Al) dark; ~Pt ₂ Al (LT) white.	232
Figure 2.190. EDX analyses of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) after annealing at 1000°C.	233
Figure 2.191. EDX analyses of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) after annealing at 1000°C.	233
Figure 2.192. XRD pattern for nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ after annealing at 1000°C.	234
Figure 2.193. 1000°C isothermal section for Pt-Al-Cr	237
Figure 2.194. BSE-SEM image of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ after annealing at 600°C: (Cr) dark; ~PtAl ₂ light.....	239
Figure 2.195. EDX analyses of nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) after annealing at 600°C.....	240
Figure 2.196. XRD pattern for nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ after annealing at 600°C.	241
Figure 2.197. BSE-SEM image of nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ after annealing at 600°C: black ~Cr ₄ Al ₉ ; grey ~Cr ₅ Al ₈ ; ~PtAl ₂ white.	242
Figure 2.198. EDX analyses of nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ (at.%) after annealing at 600°C.....	243
Figure 2.199. XRD pattern for nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ after annealing at 600°C.....	244
Figure 2.200. BSE-SEM image of nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ after annealing at 600°C: (Cr) black; ~PtAl ₂ grey; ~ Pt ₂ Al ₃ white.....	246
Figure 2.201. EDX analyses of nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ (at.%) after annealing at 600°C.....	247
Figure 2.202. XRD pattern for nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ after annealing at 600°C.	248
Figure 2.203. BSE-SEM image of nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ after annealing at 600°C: ~CrPt light; dark ~Pt ₂ Al.	249
Figure 2.204. EDX analyses of nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ (at.%) after annealing at 600°C.....	250
Figure 2.205. XRD patterns for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ . after annealing at 600°C.....	251

Figure 2.206. BSE-SEM image of nominal Pt ₆₅ :Al ₅ :Cr ₃₀ after annealing at 600°C: dark; light.	252
Figure 2.207. EDX analyses of nominal Pt ₆₅ :Al ₅ :Cr ₃₀ (at.%) after annealing at 600°C.	253
Figure 2.208. XRD patterns for nominal Pt ₆₅ :Al ₅ :Cr ₃₀ . after annealing at 600°C.	254
Figure 2.209. BSE-SEM image of nominal Pt ₃ :Al ₆₅ :Cr ₃₂ after annealing at 600°C: ~Cr ₄ Al ₉ dark; ~PtAl ₂ light.	255
Figure 2.210. EDX analyses of nominal Pt ₃ :Al ₆₅ :Cr ₃₂ (at.%) after annealing at 600°C.	256
Figure 2.211. XRD patterns for nominal Pt ₃ :Al ₆₅ :Cr ₃₂ . after annealing at 600°C.	257
Figure 2.212. BSE-SEM image of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ after annealing at 600°C: (Cr) black; ~PtAl ₂ white; ~Cr ₂ Al? grey.	259
Figure 2.213. EDX analyses of nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) after annealing at 600°C.	260
Figure 2.214. XRD patterns for nominal Pt ₃ :Al ₃₅ :Cr ₆₂ after annealing at 600°C.	261
Figure 2.215. BSE-SEM image of nominal Pt ₁₈ :Al ₂ :Cr ₈₀ after annealing at 600°C: (Cr) black; ~Cr ₃ Pt grey; ~CrPt white.	262
Figure 2.216. EDX analyses of nominal Pt ₁₈ :Al ₂ :Cr ₈₀ (at.%) after annealing at 600°C.	263
Figure 2.217. XRD pattern for nominal Pt ₁₈ :Al ₂ :Cr ₈₀ after annealing at 600°C.	264
Figure 2.218. BSE-SEM image of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ after annealing at 600°C: ~PtAl ₂ dark; T3~Pt ₂ Al ₃ ~PtAl ₂ light	265
Figure 2.219. EDX analyses of nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) after annealing at 600°C.	266
Figure 2.220. BSE-SEM image of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ after annealing at 600°C: (Cr) dark; T2/~Pt ₂ Al light; ~CrPt/~Cr ₃ Pt grey.	268
Figure 2.221. EDX analyses of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) after annealing at 600°C.	269
Figure 2.222. EDX analyses of nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) after annealing at 600°C.	269
Figure 2.223. XRD pattern for nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ after annealing at 600°C.	270
Figure 2.224. BSE-SEM image of nominal Pt ₄₃ :Al ₅₂ :Cr ₅ after annealing at 600°C: Pores/Cr black; T3~ Pt ₂ Al ₃ dark; ~PtAl light.	271
Figure 2.225. EDX analyses of nominal Pt ₄₃ :Al ₅₂ :Cr ₅ (at.%) after annealing at 600°C.	272
Figure 2.226. BSE-SEM image of nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ after annealing at 600°C: ~PtAl dark; ~Pt ₂ Al light.	273
Figure 2.227. EDX analyses of nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ (at.%) after annealing at 600°C.	274
Figure 2.228. XRD pattern for nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ after annealing at 600°C.	275
Figure 2.229. BSE-SEM image of nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ after annealing at 600°C: ~CrPt/~Pt ₃ Cr dark; ~Pt ₃ Al light; black porosity.	276
Figure 2.230. EDX analyses of nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ (at.%) after annealing at 600°C.	277
Figure 2.231. XRD pattern for nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ after annealing at 600°C.	278
Figure 2.232. BSE-SEM image of nominal Pt ₆₃ :Al ₃₂ :Cr ₅ after annealing at 600°C: ~Pt ₂ Al light; T2? dark.	279
Figure 2.233. EDX analyses of nominal Pt ₆₃ :Al ₃₂ :Cr ₅ (at.%) after annealing at 600°C.	280
Figure 2.234. XRD pattern for nominal Pt ₆₃ :Al ₃₂ :Cr ₅ after annealing at 600°C.	281
Figure 2.235. BSE-SEM image of nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ after annealing at 600°C: ~Pt ₂ Al light ~Pt ₃ Al dark.	282
Figure 2.236. EDX analyses of nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ (at.%) after annealing at 600°C.	283
Figure 2.237. XRD pattern for nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ after annealing at 600°C.	284
Figure 2.238. BSE-SEM image of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ after annealing at 600°C: dark; light.	285
Figure 2.239. EDX analyses of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ (at.%) after annealing at 600°C.	286
Figure 2.240. EDX analyses of nominal Pt ₃₄ :Al ₄₉ Cr ₁₇ (at.%) after annealing at 600°C.	287
Figure 2.241. XRD pattern for Pt ₃₄ :Al ₄₉ Cr ₁₇ after annealing at 600°C.	288

Figure 2.242. BSE-SEM image of nominal Pt ₁₅ :Al ₅ :Cr ₈₀ after annealing at 600°C: (Cr) black; ~Cr ₃ Pt/~CrPt grey; ~T ₂ white.	289
Figure 2.243. EDX analyses of nominal Pt ₁₅ :Al ₅ :Cr ₈₀ (at.%) after annealing at 600°C.	290
Figure 2.244. BSE-SEM image of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ after annealing at 600°C: T ₂ /~Pt ₃ Al dark; ~Pt ₂ Al light.	291
Figure 2.245. EDX analyses of nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) after annealing at 600°C.	292
Figure 2.246. XRD pattern for nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ after annealing at 600°C.	293
Figure 2.247. 600°C isothermal section for Pt-Al-Cr.	296
Figure 3.1. The Pt-Al-Ru liquidus surface projection as calculated by Prins et al. [2003Pri].	303
Figure 3.2. Calculated isothermal section for the Cr-Pt-Ru system for 1000°C [2006Wat] with experimental data from [2006Süs2].	305
Figure 3.3. Comparison of Al-Pt phase diagrams: a) Calculated using data from Prins [2004Pri]; b) Experimental [1990Mas].	307
Figure 3.4. Comparison of Al-Cr phase diagrams: a) Calculated using data from COST [1998Ans]; b) Experimental [1990Mas].	308
Figure 3.5. Comparison of Cr-Pt phase diagrams: a) Calculated initially by Glatzel et al. [2003Gla]; b) Experimental [1990Mas]; c) Re-created based on the work by Oikawa et al. [2001Oik].	311
Figure 3.6. Comparison of Cr-Pt phase diagrams: a) Updated calculation (this work); b) Calculated by Preussner et al. [2006Pre].	312
Figure 3.7. Extrapolation of Pt-Al, Cr-Pt and Al-Cr binary databases at 1000°C (with the ordered Pt-Al phases (L12) and Pt-Cr phases (PT3CR_L12) as separate composition sets).	315
Figure 3.8. Extrapolation of Pt-Al, Cr-Pt and Al-Cr binary databases at 1000°C (with the ordered Pt-Al and Pt-Cr phases as a single composition set).	315
Figure 3.9. Experimentally determined isothermal sections at (a) 600°C and (b) 1000°C for Pt-Al-Cr.	318
Figure 3.10. Best extrapolation of Pt-Al, Cr-Pt and Al-Cr binary databases at 1000°C with ternary phase T1 added.	318
Figure 3.11. Best extrapolation of Pt-Al, Cr-Pt and Al-Cr binary databases at 600°C with ternary phase T1 added.	319
Figure 3.12. Comparison of Pt-Al-Cr liquidus surface projections: a) Calculation (using an extrapolation of Pt-Al, Cr-Pt and Al-Cr binary databases with ternary phase T1 added.); b) Experimental (this work).	320
Figure 3.13. First calculated 1000°C isothermal section for Pt-Al-Cr with extending Pt ₂ Al.	324
Figure 3.14. Calculated 1000°C isothermal section for Pt-Al-Cr with Pt ₂ Al extending and having stability range.	325
Figure 3.15. Calculated 600°C and 1000°C isothermal sections for Pt-Al-Cr with temperature dependent terms for interaction parameters.	327
Figure 3.16. First calculated 600°C isothermal section for Pt-Al-Cr with extending Pt ₂ Al, PtAl and PtAl ₂	328
Figure 3.17. First calculated 1000°C isothermal section for Pt-Al-Cr with extending Pt ₂ Al, PtAl and PtAl ₂	328
Figure 3.18. 1000°C isothermal section for Pt-Al-Cr after further optimisation of Pt ₂ Al, PtAl PtAl ₂ and T1.	330

Figure 3.19. 1000°C and 600°C isothermal section for Pt-Al-Cr after further optimisation of L12.....	331
Figure 3.20. 1000°C and 600°C isothermal sections for Pt-Al-Cr after further optimisation of PtAl.....	332
Figure 3.21. 1000°C and 600°C isothermal sections for Pt-Al-Cr after further optimisation of PtAl.....	333
Figure 3.22. Best calculated 1000°C isothermal section for Pt-Al-Cr.....	340
Figure 3.23. Best calculated 600°C isothermal section for Pt-Al-Cr.....	340
Figure 3.24. Partial liquidus surfaces for Pt-Al-Cr calculated using (a) TCC-R, and (b) Pandat.....	343
Figure 3.25. (a) Composite liquidus surface projection created from calculations by TCC-R and Pandat, compared to (b) the experimentally determined liquidus surface projection (this work).....	344
Figure 4.1. Hardness values of as-cast Pt-Cr-Al alloys superimposed on the solidification projection.....	349
Figure 4.2. Hardness values of Pt-Cr-Al alloys annealed at 1000°C for 1000 hours, superposed on the 1000°C isothermal section.....	351
Figure 4.3. Hardness values of Pt-Cr-Al alloys annealed at 600°C for 2500 hours, superposed on the 600°C isothermal section.....	353
Figure 4.4. Optical micrographs for comparison of the hardness indentations in as-cast Pt-Cr-Al alloys.....	354
Figure 4.5. Summary of the slip modes of as-cast Pt-Cr-Al alloys, superimposed on the solidification projection.....	362
Figure 4.6. Optical micrographs for comparison of the hardness indentations in Pt-Cr-Al alloys annealed at 1000°C for 1000 hours.....	363
Figure 4.7. Summary of the slip modes of Pt-Cr-Al alloys annealed at 1000°C for 1000 hours, superimposed on the 1000°C isothermal section.....	366
Figure 4.8. Optical micrographs for comparison of the hardness indentations in Pt-Cr-Al alloys annealed at 600°C for 2500 hours.....	367
Figure 4.9. Summary of the slip modes of Pt-Cr-Al alloys annealed at 600°C for 2500 hours, superimposed on the 600°C isothermal section.....	370

LIST OF TABLES

Table 1.1. Solid phases of Cr-Pt.....	4
Table 1.2. Invariant equilibria of Cr-Pt	7
Table 1.3. Al-Pt crystal structure data [1990Mas].	11
Table 1.4. Reactions on cooling in the Pt-Al system [1990Mas].	12
Table 1.5. Enthalpies of formation for the stable phases (kJ.mol ⁻¹) [2004Pri].	16
Table 1.6. Recent Investigations on the Al-Cr system.	17
Table 1.7. Solid phases of Al-Cr.....	19
Table 1.8. Invariant equilibria of Al-Cr.....	22
Table 1.9. Thermodynamic Data of Reaction or Transformation [2002Cor2].	23
Table 2.1. Phase analyses for nominal Pt ₁₀ :Al ₁₀ :Cr ₈₀ (at.%) in the as-cast condition.....	29
Table 2.2. Phase analyses for nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) in the as-cast condition.....	31
Table 2.3. Phase analyses for nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ (at.%) in the as-cast condition.....	34
Table 2.4. Phase analyses for nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ (at.%) in the as-cast condition.....	37
Table 2.5. Phase analyses for nominal Pt ₂₀ :Al ₂₀ :Cr ₆₀ (at.%) in the as-cast condition.....	39
Table 2.6. Phase analyses for nominal Pt ₂₀ :Al ₄₀ :Cr ₄₀ (at.%) in the as-cast condition.....	43
Table 2.7. Phase analyses for nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ (at.%) in the as-cast condition.....	46
Table 2.8. Phase analyses for nominal Pt ₄₀ :Al ₁₀ :Cr ₅₀ (at.%) in the as-cast condition.	50
Table 2.9. Phase analyses for nominal Pt ₄₀ :Al ₃₀ :Cr ₃₀ (at.%) in the as-cast condition.....	54
Table 2.10. Phase analyses for nominal Pt ₄₀ :Al ₅₀ :Cr ₁₀ (at.%) in the as-cast condition.....	61
Table 2.11. Phase analyses for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ (at.%) in the as-cast condition.....	64
Table 2.12. Phase analyses for nominal Pt ₆₅ :Al ₅ :Cr ₃₀ (at.%) in the as-cast condition.	69
Table 2.13. Phase analyses for nominal Pt ₃ :Al ₆₅ :Cr ₃₂ (at.%) in the as-cast condition.	70
Table 2.14. Phase analyses for nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) in the as-cast condition.	75
Table 2.15. Phase analyses for nominal Pt ₁₀ :Al ₅₀ :Cr ₄₀ (at.%) in the as-cast condition.....	79
Table 2.16. Phase analyses for nominal Pt ₁₂ :Al ₁₈ :Cr ₇₀ (at.%) in the as-cast condition.....	83
Table 2.17. Phase analyses for nominal Pt ₁₇ :Al ₆₈ :Cr ₁₅ (at.%) in the as-cast condition.....	87
Table 2.18. Phase analyses for nominal Pt ₁₈ :Al ₂ :Cr ₈₀ (at.%) in the as-cast condition.	91
Table 2.19. Phase analyses for nominal Pt ₂₈ :Al ₁₂ :Cr ₆₀ (at.%) in the as-cast condition.....	92
Table 2.20. Phase analyses for nominal Pt ₂₈ :Al ₇₀ :Cr ₂ (at.%) in the as-cast condition.	95
Table 2.21. Phase analyses for nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) in the as-cast condition.	99
Table 2.22. Phase analyses for nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) in the as-cast condition.....	103
Table 2.23. Phase analyses for nominal Pt ₄₃ :Al ₅₂ :Cr ₅ (at.%) in the as-cast condition.	106
Table 2.24. Phase analyses for nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ (at.%) in the as-cast condition.....	108
Table 2.25. Phase analyses for nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ (at.%) in the as-cast condition.....	112
Table 2.26. Phase analyses for nominal Pt ₆₀ :Al ₂ :Cr ₃₈ (at.%) in the as-cast condition.	114
Table 2.27. Phase analyses for nominal Pt ₆₃ :Al ₃₂ :Cr ₅ (at.%) in the as-cast condition.	118
Table 2.28. Phase analyses for nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ (at.%) in the as-cast condition.....	121
Table 2.29. Phase analyses for nominal Pt ₇₈ :Al ₁₇ :Cr ₅ (at.%) in the as-cast condition.	123
Table 2.30. Phase analyses for nominal Pt ₃₄ :Al ₄₉ :Cr ₁₇ (at.%) in the as-cast condition.....	127
Table 2.31. Phase analyses for nominal Pt ₃ :Al ₇₉ :Cr ₁₈ (at.%) in the as-cast condition.	131
Table 2.32. Phase analyses for nominal Pt ₅ :Al ₅₂ :Cr ₄₃ (at.%) in the as-cast condition.	135
Table 2.33. Phase analyses for nominal Pt ₁₃ :Al ₄₅ :Cr ₄₂ (at.%) in the as-cast condition.....	138
Table 2.34. Phase analyses for nominal Pt ₁₅ :Al ₅ :Cr ₈₀ (at.%) in the as-cast condition.	141
Table 2.35. Phase analyses for nominal Pt ₃₄ :Al ₂₇ :Cr ₃₉ (at.%) in the as-cast condition.....	144
Table 2.36. Phase analyses for nominal Pt ₃₇ :Al ₅₉ :Cr ₄ (at.%) in the as-cast condition.	147
Table 2.37. Phase analyses for nominal Pt ₄₅ :Al ₃₅ :Cr ₂₀ (at.%) in the as-cast condition.....	149
Table 2.38. Phase analyses for nominal Pt ₅₂ :Al ₄₃ :Cr ₅ (at.%) in the as-cast condition.	152

Table 2.39. Phase analyses for nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) in the as-cast condition.....	156
Table 2.40. Phase analyses for nominal Pt ₅₅ :Al ₂₀ :Cr ₂₅ (at.%) in the as-cast condition.....	159
Table 2.41. Phase analyses for nominal Pt ₆₄ :Al ₁₆ :Cr ₂₀ (at.%) in the as-cast condition.....	163
Table 2.42. Phase analyses for nominal Pt ₈ :Al ₈₉ :Cr ₃ (at.%) in the as-cast condition.	166
Table 2.43. Phase analyses for nominal Pt ₈ :Al ₈₉ :Cr ₃ (at.%) in the as-cast condition.	169
Table 2.44. Solidification reactions in the Pt-Al-Cr system.	174
Table 2.45. Ternary invariant reactions in the Pt-Al-Cr system.	178
Table 2.46. Phase analyses for nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) after annealing at 1000°C.	182
Table 2.47. Phase analyses for nominal Pt ₁₀ :Al ₈₀ :Cr ₁₀ (at.%) after annealing at 1000°C.	186
Table 2.48. Phase analyses for nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ (at.%) after annealing at 1000°C.	189
Table 2.49. Phase analyses for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ (at.%) after annealing at 1000°C.	193
Table 2.50. Phase analyses for nominal Pt ₆₅ :Al ₅ :Cr ₃₀ (at.%) after annealing at 1000°C.	195
Table 2.51. Phase analyses for nominal Pt ₃ :Al ₆₅ :Cr ₃₂ (at.%) after annealing at 1000°C.	198
Table 2.52. Phase analyses for nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) after annealing at 1000°C.	200
Table 2.53. Phase analyses for nominal Pt ₁₈ :Al ₂ :Cr ₈₀ (at.%) after annealing at 1000°C.	202
Table 2.54. Phase analyses for nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) after annealing at 1000°C.	206
Table 2.55. Phase analyses for nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) after annealing at 1000°C.	209
Table 2.56. Phase analyses for nominal Pt ₄₃ :Al ₅₂ :Cr ₅ (at.%) after annealing at 1000°C.	213
Table 2.57. Phase analyses for nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ (at.%) after annealing at 1000°C.	214
Table 2.58. Phase analyses for nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ (at.%) after annealing at 1000°C.	217
Table 2.59. Phase analyses for nominal Pt ₆₃ :Al ₃₂ :Cr ₅ (at.%) after annealing at 1000°C.	220
Table 2.60. Phase analyses for nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ (at.%) after annealing at 1000°C.	224
Table 2.61. Phase analyses for nominal Pt ₃₄ :Al ₄₉ :Cr ₁₇ (at.%) after annealing at 1000°C.	227
Table 2.62. Phase analyses for nominal Pt ₁₅ :Al ₅ :Cr ₈₀ (at.%) after annealing at 1000°C.	229
Table 2.63. Phase analyses for nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) after annealing at 1000°C.	232
Table 2.64. Phase analyses for nominal Pt ₁₀ :Al ₃₀ :Cr ₆₀ (at.%) after annealing at 600°C.	239
Table 2.65. Phase analyses for nominal Pt ₁₀ :Al ₆₀ :Cr ₃₀ (at.%) after annealing at 600°C.	243
Table 2.66. Phase analyses for nominal Pt ₃₀ :Al ₅₀ :Cr ₂₀ (at.%) after annealing at 600°C.	246
Table 2.67. Phase analyses for nominal Pt ₅₀ :Al ₁₀ :Cr ₄₀ (at.%) after annealing at 600°C.	249
Table 2.68. Phase analyses for nominal Pt ₆₅ :Al ₅ :Cr ₃₀ (at.%) after annealing at 600°C.	252
Table 2.69. Phase analyses for nominal Pt ₃ :Al ₆₅ :Cr ₃₂ (at.%) after annealing at 600°C.	255
Table 2.70. Phase analyses for nominal Pt ₃ :Al ₃₅ :Cr ₆₂ (at.%) after annealing at 600°C.	259
Table 2.71. Phase analyses for nominal Pt ₁₈ :Al ₂ :Cr ₈₀ (at.%) after annealing at 600°C.	263
Table 2.72. Phase analyses for nominal Pt ₃₅ :Al ₅₅ :Cr ₁₀ (at.%) after annealing at 600°C.	266
Table 2.73. Phase analyses for nominal Pt ₃₈ :Al ₂₂ :Cr ₄₀ (at.%) after annealing at 600°C.	268
Table 2.74. Phase analyses for nominal Pt ₄₃ :Al ₅₂ :Cr ₅ (at.%) after annealing at 600°C.	271
Table 2.75. Phase analyses for nominal Pt ₅₀ :Al ₃₅ :Cr ₁₅ (at.%) after annealing at 600°C.	273
Table 2.76. Phase analyses for nominal Pt ₅₈ :Al ₁₀ :Cr ₃₂ (at.%) after annealing at 600°C.	277
Table 2.77. Phase analyses for nominal Pt ₆₃ :Al ₃₂ :Cr ₅ (at.%) after annealing at 600°C.	279
Table 2.78. Phase analyses for nominal Pt ₆₃ :Al ₂₂ :Cr ₁₅ (at.%) after annealing at 600°C.	282
Table 2.79. Phase analyses for nominal Pt ₃₄ :Al ₄₉ :Cr ₁₇ (at.%) after annealing at 600°C.	286
Table 2.80. Phase analyses for nominal Pt ₁₅ :Al ₅ :Cr ₈₀ (at.%) after annealing at 600°C.	290
Table 2.81. Phase analyses for nominal Pt ₅₅ :Al ₂₅ :Cr ₂₀ (at.%) after annealing at 600°C.	292
Table 3.1. Excerpt from Pt-Al-Cr database with the ordered Pt-Al phases (L12) and Pt-Cr phases (PT3CR_L12) shown as separate composition sets.	313
Table 3.2. Excerpt from Pt-Al-Cr database with the ordered Pt-Al phases and Pt-Cr phases shown as a single composition set (L12).	314
Table 3.3. Excerpt from Pt-Al-Cr database showing how ternary phase T1 (TAO_1) was modelled.	316

Table 3.4. Excerpt from Pt-Al-Cr database showing how ternary phase Pt ₂ Al was initially modelled.....	322
Table 3.5. Excerpt from Pt-Al-Cr database showing how ternary phase Pt ₂ Al was modelled with the introduction of interaction parameters.	322
Table 3.6. Excerpt from Pt-Al-Cr database showing the Pt ₂ Al model after further optimisation.....	326
Table 3.7. Excerpt from Pt-Al-Cr database showing the parameters for Pt ₂ Al, PtAl, PtAl ₂ and TAO_1 after further optimisation.....	329
Table 3.8. Excerpt from Pt-Al-Cr database showing the parameters for PtAl after further optimisation yielding good results at 1000°C.	332
Table 3.9. Excerpt from Pt-Al-Cr database showing the parameters for PtAl after further optimisation yielding good results at 600°C.	333
Table 3.10. Excerpt from Pt-Al-Cr database showing the parameters for PtAl after further optimisation yielding good results at both 600°C and 1000°C.....	333
Table 3.11. Excerpt from Pt-Al-Cr database showing tweaked parameters for Pt ₂ Al.	334
Table 3.12. Excerpt from Pt-Al-Cr database showing a parameter for PtAl ₂ after further optimisation.....	334
Table 3.13. The calculated model parameters for Pt-Al-Cr.....	335
Table 3.14. Comparison between the experimental and calculated results at 600°C and 1000°C.	341
Table 4.1. Hardness values of as-cast Pt-Cr-Al alloys (HV ₁₀).	347
Table 4.2. Hardness values of Pt-Cr-Al alloys annealed at 1000°C for 1000 hours (HV ₁₀) compared to as-cast hardness values.	350
Table 4.3. Hardness values of Pt-Cr-Al alloys annealed at 600°C for 2500 hours (HV ₁₀) compared to as-cast and 1000°C hardness values.	352