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

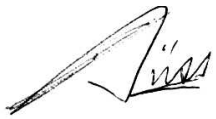
Rainer Süss

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.



_____ 15/1/2008

SIGNATURE DATE

ACKNOWLEDGEMENTS

I would like to thank the following people for their contribution to this work:

- My supervisor and friend, Dr. Lesley Cornish, for encouraging me to do this, and sharing her technical expertise, whether across a desk, or over a beer or curry.
- Dr. Andy Watson for friendly and very useful advice on the modelling work, interesting conversations at The Eldon in Leeds - and many cups of tea.
- Bernard Joja for countless hours of work at the SEM.
- Stefanie Taylor, Alistair Douglas and Lizelle Glaner for running a myriad of XRD scans.
- Edson Muhuma for sectioning all the samples and doing the OPS polishing.
- MINTEK for granting me this opportunity and financial assistance.
- The PDI for the platinum used in this investigation and support for the project.
- The Wits DST/NRF Centre of Excellence in Strong Materials for plane tickets to the UK.
- Ma en Pa, vir hulle liefde en ondersteuning deur die jare.
- And last, but not least, my wonderful Diandree, for being my loving wife and supporting me throughout.

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 HV_{10} 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 ~Pt_3Al showed better behaviour with regard to toughness which was encouraging for the Pt-based alloys that are being developed by Mintek.

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