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

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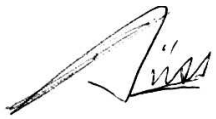
DECLARATION

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.



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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 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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