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ASPECTS OF THE CHEMISTRY OF TITANIUM DIOXIDE IN FUSED SALT SOLVENTS

A Thesis
Submitted to the University of Auckland for the Degree of Doctor of Philosophy

by

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ABSTRACT

An investigation into the chemistry of solutions of titanium dioxide in fused alkali metal borates has been made, with the emphasis on the ability of the alkali borate melts to dissolve TiO₂ and subsequently crystallise TiO₂ and/or complex alkali metal titanates.

The preparation and properties of potassium titanates with K₂O/TiO₂ mol ratio < 1 has been studied. In addition the thermal decomposition of potassium hexafluorotitanate monohydrate (reported to yield potassium tetratitanate) has been investigated. The decomposition product has been identified as an oxyfluorotitanate.

The compounds crystallised on slow cooling of alkali borate + TiO₂ melts have been identified. The titanium containing product(s) have been correlated with the concentration of borate groups containing non-bridging oxygens, which depends on the alkali metal cation. Phase diagrams for the M₂O-B₂O₃ + TiO₂ (M = Na, K) systems have been obtained. Mass transport in M₂O.2B₂O₃ + TiO₂ (M = Li, Na, K) systems has been studied, via measurements of electrical conductivity, as a function of temperature and TiO₂ concentration.

Additional information on the alkali borate melts has been obtained from measurements of the optical basicity of M₂O + B₂O₃ (M = Li, Na, K, Rb, Cs) glasses, using Pb(II) as probe ion. The results of these measurements have confirmed that the nature of the alkali metal cation significantly affects the basicity of fused alkali borate solvents.

Extraction of TiO₂ from ilmenite and titaniferous slag, using selected low-basicity alkali borate solvents has been attempted. The results indicate that TiO₂ may be separated from ilmenite in essentially a one-step process.
# TABLE OF CONTENTS

## CHAPTER ONE - INTRODUCTION

1.1 Some Current Method of TiO₂ Extraction  
1.2 Preliminary Investigations into the Extraction of Titanium  
1.3 The Solubility of TiO₂ in Molten Salts  
1.4 Overview  
References  

## CHAPTER TWO - PART I: PREPARATION AND PROPERTIES OF POTASSIUM TITANATES

2.1 Introduction  
2.2 Experimental Detail  
2.3 Results and Discussion  
  2.3.1 Potassium Metatitanate  
  2.3.2 Potassium Dititanate  
  2.3.3 Potassium Tetratinonate  
  2.3.4 Potassium Hexatitanate  
2.4 Summary  

### PART II: UNIT CELL PARAMETERS OF POTASSIUM METATITANATE AND POTASSIUM TETRATITANATE, AND THE THERMAL DECOMPOSITION OF POTASSIUM HEXAFLUOROTITANATE

2.5 Introduction  
2.6 Experimental Detail  
2.7 Results and Discussion  
References  

Page
1  
3  
4  
5  
7  
9  
10  
11  
13  
15  
18  
21  
21  
25  
25  
26  
26  
32
CHAPTER THREE - PART I: ACID-BASE REACTIONS IN FUSED ALKALI BORATE + TiO₂ MIXTURES

3.1 Introduction 34
3.2 Experimental Detail 35
3.3 Results 38
  3.3.1 Lithium Borate Melts 38
  3.3.2 Sodium Borate Melts 41
  3.3.3 Potassium Borate Melts 41
  3.3.4 Rubidium and Cesium Borate Melts 42
3.4 Discussion 43
  3.4.1 Basicity of the Solvent and Effect of the Alkali Metal Cation 43
  3.4.2 The Structure of Borate Melts in Relation to Basicity 44
3.5 Conclusions 47

PART II: PHASE EQUILIBRIA IN TiO₂ + ALKALI METAL BORATE SYSTEMS 49

3.6 Introduction 49
3.7 Experimental Detail 49
3.8 Results and Discussion 50
References 56

CHAPTER FOUR - OPTICAL BASICITIES OF ALKALI BORATE GLASSES 58

4.1 Introduction 58
4.2 Experimental Detail 60
4.3 Results 61
4.4 Discussion 62
References 78