

CONTENTS

Part I : GENERAL PROCEDURES

1. Chemistry of Titanium	3
Introduction	3
Preparation of Titanium Metal	3
Properties of Compounds	4
Electrode Potentials and Thermodynamic Data	9
2. Sampling and Dissolution of Titanium-Base Materials	14
Sampling	14
Dissolution	15
3. General Separation Procedures for Titanium-Rich Materials	20
Precipitation	20
Extraction	23
Ion Exchange Separations	24
Procedures for Use with a Master Solution	24
4. Emission Spectrographic Methods Applicable to Titanium-Rich Materials	28
Emission Spectrochemical Analysis of Vanadium and Iron in Titanium Tetrachloride	36
Spectrographic Determination of Oxygen in Titanium Metals	38
Spectrographic Determination of Zirconium in Titanium Metals and Compounds	46
5. Vacuum Line Methods Applicable to Titanium-Rich Metals	47
Determination of Oxygen and Hydrogen	47
Determination of Hydrogen Alone	69
6. Determination of Titanium in Various Substances	87

**Part II : DETERMINATION OF METALLIC ELEMENTS IN TITANIUM AND
TITANIUM ALLOYS**

Introduction	105
7. Aluminum	108
8. Vanadium, Tantalum, and Niobium	122
Vanadium	122
Tantalum and Niobium	127
9. Chromium	132
Simultaneous Polarographic Determination of Chromium and Estimation of Iron	139
10. Molybdenum	141
11. Tungsten	155
12. Manganese	170

13. Iron and Tin	178
Iron	178
Tin	186
14. Copper, Nickel, and Cobalt	192
Copper	192
Nickel	195
Cobalt	199
15. Titanium and Zirconium	203
Titanium	203
Zirconium	213
16. Magnesium, Beryllium, Calcium, Sodium, Lead, Silver, and Rare Earths	218
Magnesium	218
Beryllium	223
Calcium	224
Sodium	228
Lead	229
Silver	230
Rare Earth Metals	230

**Part III : DETERMINATION OF NONMETALLIC ELEMENTS IN TITANIUM
AND TITANIUM ALLOYS**

Introduction	235
17. Hydrogen, Carbon, and Silicon	236
Hydrogen	236
Carbon	238
Silicon	248
18. Nitrogen and Phosphorus	253
Nitrogen	253
Phosphorus	256
19. Boron	260
20. Oxygen and Sulfur	268
Oxygen	268
Sulfur	279
21. Chlorine	284

Part IV : ANALYSIS OF TITANIUM-BASE MATERIALS

22. Analysis of Titanium Tetrachloride	291
Free Chlorine	291
Silicon	291
Sulfur	293
Phosphorus	293
Iron	295
Vanadium	295
Impurities	302
23. Analysis of Titanium-Base Pigments	308
Qualitative Analysis of White or Tinted Pigments Containing Titanium	308
Analysis of Pigments in Which Titanium Compounds Are among the Major Constituents	309
24. Analysis of Titanium Dioxide Pigments	315
Titanium Dioxide	316
Iron	316
Antimony	319
Aluminum	323
Zinc	324
Chromium	326
Vanadium	328
Copper	329
Nickel	331
Arsenic	333
Silver	335
Silicon	336
Phosphorus	337
25. Analysis of Titanium Minerals, Ores, Concentrates, and Slags	338
Titanium Dioxide	338
Iron	339
Aluminum, Calcium, and Magnesium Oxides in Various Titanium Ores and Concentrates	346
Manganese in Ilmenite	349
Chromium in Ores	350
Vanadium in Ores	351
Zirconium Oxide and Silica in Various Titanium Minerals and Ores	352
Arsenic in Titanium Minerals, Ores, and Pigments	353
Sulfur in Titanium Ores, Minerals, Slags, and Concentrates	355
Phosphorus in Titanium Ores, Minerals, and Concentrates	358
References	362
Author Index	369
Subject Index	373