Contents

	List o	f Contributors	X
	Prefa	ce	xiii
1	Histo	rical Background	1
	JAC	Cookson	
	1.1	Analysis and imaging techniques	1
	1.2	Collimated microbeams	3
	1.3	Focused microbeams	9
	1.4	Use of microbeams	17
	1.5	References	18
2	Analy	tical Techniques	21
	J A Cookson		
	2.1	Introduction	21
	2.2	Particle-induced X-ray emission (PIXE)	24
	2.3	Nuclear reaction analysis (NRA)	43
	2.4	Rutherford back-scattering (RBS)	57
	2.5	Elastic recoil detection analysis (ERDA)	65
	2.6	Conclusions	72
	2.7	References	74
3	Focus	ing High-Energy Ion Beams	79
	GW	Grime and F Watt	
	3.1	Probe formation	80
	3.2	The quadrupole lens	83
	3.3	Aberrations of quadrupole systems	88
	3.4	Beam optics of some existing quadrupole microprobes	99
	3.5	Other focusing devices	103
	3.6	Towards sub-micron ion probes	105
	3.7	References	110

	~
VIII	Contents

4	Praction	cal Aspects of Heavy-Ion Microbeams	113
	GWC		
	4.1	Accelerators	114
	4.2	Construction of focusing systems	118
	4.3	Scanning systems	124
	4.4	Detectors	127
	4.5	Target chamber design	135
	4.6	Data acquisition	142
	4.7	Data processing and presentation of results	144
	4.8	Optimisation and alignment of a quadrupole	
		microprobe	147
	4.9	Measurement of the spot diameter	149
	4.10	References	150
5	Microl	beam Applications in Biology	154
	F Watt and G W Grime		
	5.1	Introduction	154
	5.2	Analysis of botanical specimens	162
	5.3	Analysis of soft animal tissue	169
	5.4	Analysis of hard tissue	174
	5.5	Analysis of cells	180
	5.6	Concluding remarks	195
	5.7	Acknowledgments	198
	5.8	References	198
6	Microl	beam Applications in Medicine	203
	D J T Vaux, F Watt and G W Grime		
	6.1	Introduction	203
	6.2	Sample preparation	205
	6.3	Proton microbeam analysis of hair, skin and	
		teeth	208
	6.4	Proton microprobe analysis of skeletal tissue	213
	6.5	Analysis of blood cells	215
	6.6	Analysis of hepatic tissue	217
	6.7	Analysis of human nervous tissue	227
	6.8	Acknowledgments	231
	6.9	References	231

		Contents	IX
7	Microb	peam Applications in the Earth Sciences	238
	F Wat	t, G W Grime and D G Fraser	
	7.1	Introduction: microanalytical techniques in	
		geochemistry	238
	7.2	The problems of using PIXE on geochemical samples	240
	7.3	Specific applications of microbeams in geology	255
	7.4	Conclusions	269
	7.5	Acknowledgments	270
	7.6	References	270
8	Microl	beam Applications in Metallurgy and Industry	273
	J A Co	ookson	
	8.1	Introduction	273
	8.2	Metallurgical applications	273
	8.3	Industrial applications to non-metals	289
	8.4	References	297
9	Microl	beam Applications in Solid State Physics and	
	Electro		299
	JSW	illiams, J C McCallum and R A Brown	
	9.1	Introduction	299
	9.2	Ion beams and semiconductors: background	300
	9.3	Microbeam analysis of semiconductor materials	312
	9.4	Further applications to semiconductor structures	325
	9.5	Conclusions	331
	9.6	References	331
10	Microl	beam Applications in Archaeology	333
	G Den	nortier	
	10.1	Advantages and limitations of high-energy ion	
		probes for archaeological material	333
	10.2	Papers of historical documents	337
	10.3	Bones and teeth	339
	10.4	Clays and sherds	340
	10.5	Glasses and obsidians	345
	10.6	Iron- and copper-based alloys	348
	10.7	Silver and gold	353
	10.8	Conclusions	374
	10.9	Acknowledgments	374
	10 10	References	375

	~	
v	Contents	٠
•	COMECHE	١

11	Other Applications of Ion Microbeams J A Cookson		378
	11.1	Introduction	378
	11.2	Analytical applications	378
	11.3	Non-analytical microbeam techniques	384
	11.4	References	394
Index		395	
Pla	tes 1–1	0	facing 305