

Contents

1	Introduction	1
	References	3
2	Developments in Field Emission Gun Technologies and Advanced Detection Systems	5
2.1	Cold-Field Emission Technology	5
2.2	CFE-SEM for Low Voltage Microscopy	8
2.3	Scanning Transmission Microscopy in the SEM	11
	References	11
3	Electron Detection Strategies for High Resolution Imaging: Deceleration and Energy Filtration	13
3.1	Principles	13
3.2	Application of Dual In-Lens Electron Detection	22
3.3	Energy filtration	26
	References	34
4	Low Voltage SEM	37
4.1	Strategy of Characterization: Deceleration and Energy Filtration	38
4.2	High Resolution Imaging	39
4.3	Low Voltage, Specimen Charging, and Material Contrast	41
4.4	Ultra-Low Voltage SEM: Uses and Limitations	43
	References	45
5	Low Voltage STEM in the SEM	47
	References	52
6	The f-Ratio Method for X-Ray Microanalysis in the SEM	55
6.1	The Limits of X-Ray Microanalysis Models	55
6.2	Description of the f-Ratio Method	55

6.2.1	f-Ratio Method for Binary System	57
6.2.2	Generalization of the f-Ratio Method for Multi-elements	59
6.3	Examples of Quantitative X-Ray Analysis Using the f-Ratio Method	59
6.3.1	Binary Examples	59
6.3.2	Multi-elements Example	61
6.4	Summary	63
	References	63
7	X-Ray Imaging with a Silicon Drift Detector Energy Dispersive Spectrometer	67
7.1	X-Ray Emission Rate with Low Accelerating Voltage and Thin Film	68
7.2	Comparison of Silicon Drift Detector Geometry	70
7.2.1	Solid Angle	71
7.2.2	Takeoff Angle	72
7.3	X-Ray Map Acquisition at High Spatial Resolution and High Signal-to-Noise Ratio	74
7.3.1	Low Accelerating Voltage	75
7.3.2	Low Voltage STEM	77
7.3.3	Phase Map Analysis	79
7.3.4	Removal of the Effect of Electron Channeling on X-Ray Emission in Thin Specimens	81
7.4	Summary	82
	References	82
8	Electron Diffraction Techniques in the SEM	85
8.1	Electron Channeling Contrast Imaging	86
8.2	Low Voltage STEM Defects Imaging	89
8.3	Electron Backscatter Diffraction	91
8.4	Dark-Field Electron Backscatter Diffraction	93
8.5	Transmission Forward Electron Backscatter Diffraction	96
8.6	Dark-Field Imaging with a Forecaster Detector in Transmission Mode	100
	References	101
9	Magnetic Domain Imaging	107
9.1	Type-I Contrast	107
9.2	Type-II Contrast	108
9.3	Type-III Contrast	111
	References	112

10	Advanced Specimen Preparation	115
10.1	Surface Preparation	115
10.2	Surface Cleaning	119
10.3	Charging Compensation with Ionic Liquid Treatment	122
	References	126
11	Conclusion and Perspectives	129
	Index	133

Field Emission Scanning Electron Microscopy

New Perspectives for Materials Characterization

Brodusch, N.; Demers, H.; Gauvin, R.

2018, XII, 137 p. 53 illus., 20 illus. in color., Softcover

ISBN: 978-981-10-4432-8