

Harald Ibach

Electron Energy Loss Spectrometers

The Technology of High Performance

With 103 Figures

Springer-Verlag

Berlin Heidelberg New York London
Paris Tokyo Hong Kong Barcelona

Contents

1. Introduction	1
2. The Computational Procedures	4
2.1 General Strategy	4
2.2 The Solution of the Laplace Equation	6
2.3 Electron Trajectories	8
2.4 Space Charge Limited Current	12
3. The Electron Optics of the Cylindrical Deflector	15
3.1 The Ideal Cylindrical Field	15
3.2 The Cylindrical Deflector Terminated with Equipotential Electrodes	21
3.3 Transmission of the Cylindrical Deflector	28
3.4 Numerical Simulation of the Transmission	35
3.5 Dispersion Compensation Spectrometers	41
4. The Electron Optics of the Ideal Cylindrical Field with Space Charge	45
4.1 Solution of the Lagrange Equation	45
4.2 Analytical First-Order Solutions for the Space Charge Problem	48
4.3 Space Charge in a Spherical Deflector	52
4.4 Numerical Calculation of Space Charge Effects	55
5. Electron Optics of Real Cylindrical Deflectors Loaded with High Current	65
5.1 Monochromators	65
5.2 Retarding Monochromators	78
6. Electron Emission Systems	87
6.1 Basic Concepts	87
6.2 Technical Aspects of the Calculations	90
6.3 Three Different Emission Systems	96
6.4 Electron Optical Properties of the Three Different Emission Systems	101

7. Lens Systems	115
7.1 Concepts in Inelastic Electron Scattering	115
7.2 Image Formation and Momentum Resolution	123
7.3 Examples of Lens Systems	131
7.4 The Pupils of the Spectrometer	147
8. Comparison of Experiment and Simulation	150
8.1 Layout of the Spectrometer	150
8.2 The Analyser	155
8.3 Emission System and Pre-monochromator	158
8.4 The Second Monochromator and the Lens System	163
References	173
Subject Index	177