

Additional References with Titles

Chapter 3

- G.Boivin: Use of a Fresnel zone plate for optical image formation with short wavelength radiation. *Appl. Opt.* **16**, 1070 (1977)
- A.Franks: X-ray Optics Science Progress, Oxf. **64**, 371 (1977)
- E.Gipstein, A.C.Ouano, D.E.Johnson, O.U.Need III: Parameters affecting the sensitivity of Poly (methyl methacrylate) as a positive lithographic resist. *Polymer Engineering and Science* **17**, 396 (1977)
- K. Murase, M. Kakuchi, S. Sugawara: Newly developed electron and X-ray resist materials. Intern. Conf. on Microlithography (Paris 1977) p. 261

Chapter 4

1. P.A.Bezirganyan: A three-wave method for the measurement of the length of a wave-train of X-ray radiation. *Phys. stat. sol. (a)* **40**, K 77 (1977)
2. U. Bonse, W. Graeff: On the possibility of measuring the length of X-ray or neutron wave trains with the three-beam case interferometer. Submitted to *phys. stat. sol. (a)* (1977)
3. D.C.Creagh: Determination of the mass attenuation coefficients and anomalous dispersion corrections for calcium for X-ray wavelengths from $\text{IK}\alpha_1$ to $\text{CuK}\alpha_1$. *Phys. stat. sol. (a)* **39**, 705 (1977)
4. H. Kaiser, H. Rauch, W. Bauspiess, U. Bonse: Measurement of the coherent neutron scattering length of ^3He by neutron interferometry. Submitted to *Phys. Lett. B* (1977)
5. H. Rauch, D. Petrascheck: "Dynamical Diffraction on Perfect Crystals and its Application in Neutron Physics", in *Neutron Diffraction*, ed. by H. Dachs, Topics in Current Physics; in preparation (Springer, Berlin, Heidelberg, New York 1978)
6. H. Rauch, E. Seidl, A. Zeilinger, W. Bauspiess, U. Bonse: Hydrogen detection in metals by neutron interferometry. Submitted to *J. Appl. Phys.* (1977)

Subject Index

- Aberration 121
- Absolute measurement of lattice parameters 131
- Absorber pattern 39, 41
- Absorption 98-102, 108, 117, 133, 215
 - , anomalous 105
 - coefficient 37, 38
 - thickness 138
- ACO storage ring 47
- Acoustic surface wave transducer 79
- Additive electroplating 72
 - lift-off 71
- Aethylalcohol 135
- Al 135
- Aligning, self- 68
- Alignment configuration 65
 - , geometries 66
 - , optical 67
 - , X-ray 67
- Allowable load 13
- Alum 186
- Amplitude ratio 101, 102, 109
- Amplitudes 115
- Analyzers 109
- Anomalous transmission 159, 164, 168
- Antinodes 160
- Ashing 71
- Aspect ratio 84

- Back-scattered electrons 25
- BBB-interferometer 125
- Be 135
- Beam divergence 171
 - mirror 108, 109
 - splitter 96, 100, 105, 108
- Berg-Barret method 192
- Biological objects, microscopy 82
- Biprism 94, 96
- Bloch wave 154
- Blurring, penumbral 36
- Borrmann effect 102, 152, 160
 - fan 118, 147, 163
 - triangle 161, 166, 176

- Boundaries, associated with strain 185
- Boundary condition for wave vectors 157
- Bracket notation 100
- Bragg angle 157
 - case beam splitter 105, 108
 - condition 191
 - interferometer 125
- Bremsstrahlung 44, 134
- Brilliance of X-ray sources 12
- Burgers vector 169

- CaF₂ 135
- Chain scission 54
- Characteristic lines 43
- Characterization methods of resists, comparison 58
 - of defects 145
- Coherent scattering length 133
- Component translation 110
- Components of interferometers 98
- Conservation of particles 96
- Contrast 44, 54, 119, 152, 172, 214
 - , calculations 119
 - , effective 44
 - function 110
 - , interference 117
 - of defect image 214
 - - defects 152
 - - direct images 172
 - - mask 43, 52
 - - resist, definition 57
 - Conversion efficiency 44
- Coplanar three-beam case 109
- Crosslinking 54
- Crystal growth 199, 205

- Damage, X-ray induced 81
- DCIPA 48, 60
- Defect position 171
- Defects 145, also see dislocations, stacking faults, etc.
 - , planar 177
- Defocusing 119, 120

- Deformed crystals 166
- DESY 46
- Detector systems 216
- Deviation parameter 158, 166
- Devices, magnetic bubble 79
 - , semiconductor 80
 - , single level 79
- Dielectric susceptibility 99
- Diffracting gratings 79
 - wedge 135
- Diffraction, dynamical theory 152
- Diffuse scattering 2
- Digital processing of images 191
- Direct beam topography 150
- Direct-display systems 194
- Direct image 146, 169–172, 201
- Direct-view image 200
- Dislocation core 170
 - , depth of 170
 - , image 146, 151, 169, 171
 - mobility 194
 - , moving 205
 - , partial 183
- Dislocations 28, 130, 146, 151, 169, 174, 183, 191, 199, 205
- Dispersion surface 135, 156, 159, 163, 166, 178
- Dispersive effects 5
- Displacement in Angstrom range 132
- Display, direct 194
- Dissolution rate 54, 55
- Distortion, geometrical 36
- Divergent Laue method 206
- Double-crystal arrangement 150, 192
 - method 192
 - topography 149
- Dynamical image 173
 - theory 98, 145, 150
- Effective contrast 44, 47
 - misorientation 161, 166, 184
 - range 59
- Efficiency, conversion 44
- Electric slit 200
- Electron beam 43
 - – evaporation 43
 - – system 36
 - guns 19
 - microscope 82
 - synchrotron, see synchrotron
- Electronic image processing 217
- Electrons, secondary 44–46, 59
 - , –, range 59
- Electro-optical system for topography 195
- Electroplating 72
- Energy flow 104, 118
- ESCA 2
- Etching, plasma 71
 - , sputter 71
 - , wet chemical 70
- Ewald sphere 156
- EXAFS 133
- Exposure, parallel 76
 - , single wafer 77
- Extinction distance 101, 122
- Fault surface 179
- Fermi pseudopotential 99
- Fiber-optic plate 196
- Field effect transistors 81
 - of view 215
- Fluorescent screen 207, 212
- Focusing elements 86
 - points 119
- Foil target 14
- Foldy interaction 93, 133
- Fore crystal 97
- Fourfold Laue-case interferometer 97
- Fourier transform 111, 162
 - – spectroscopy 97, 129
- Fresnel plate 86
- Fringe distance of Pendellösung 158
 - processing 132
- Fundamental constants 131
- GaAs 81
- Ge 97
- Generators, microfocus 26
 - , pulsed 31
 - , rotary anode 25
 - , soft X-ray 27
- Geometrical distortion 36
- Glycerine 135
- Gravitational acceleration 139
- Gravity 128, 139
- Grazing incidence 87
- Growth striations 145, 199
- Holography 129
 - , X-ray 97
- Horizontal resolution 211
- Hourglass shape 181
- Ideal geometry 116
 - resist 49
- Image broadening 211
 - , direct view 200
 - , dynamical of topography 173
 - , formation 171
 - , intermediary 175

- of defect, contrast 214
- planar defects 177
- , processing 191
- , electronic 217
- Imaging multiple-stage 206, 209
- single-stage 196
- Inclusions 148
- Incoherent processes 99
- Input power, maximum 13
- Integrated circuits 197, 203
- Intensity, distribution 114, 120, 163
- Interbranch scattering 169
- Interferometer, achromatic 119, 126
- , actual devices for X-rays 97
- , application 128
- , Bragg case 125
- components 98
- , for neutrons 96
- , light optical 132
- , LLL 124
- , manufacture of 97
- , Michelson-type 128
- , mixed case 126, 127
- , poly lithic 122
- , skew-symmetric 123
- , three-beam case 126
- Interferometry 93, 95, see interferometer
- , biprism 94
- , Michelson 94
- , operator scheme 96
- , principles of 95
- Intermediary image 175, 186
- Inversion symmetry 104
- Ion implantation 73, 213
- milling 71

- Kato fringes 164
- Kinematical image topography 150
- model of contrast 172

- λ -thickness 134, 138
- Lang method 147, 192
- Lasers 2, 4, 129
- , X-ray 129
- Lattice defects, see dislocations, stacking faults, etc.
- parameters 128
- , absolute measurement 131
- Laue case 97, 124, 207
- - interferometers 97
- image, magnification 207
- method, divergent 207
- point 158
- reflex 191

- LiF 135
- Limitations of neutron topography 150
- Limited projection topography 149
- Lithographic systems 75, 78
- Lithography 35
- Live topography 191
- Localization of new wave fields 183, 184
- Lorentz point 158
- Lucite 135

- Magnetic bubble devices 79
- Magnetization of atom 133
- Magnification of topography 216
- Magnified Laue spots 207
- Manufacture of interferometers 97
- Margin effect 164
- Mask alignment 64
- , contrast 43
- , life 85
- , substrate 39
- Masks 39, 43, 52, 64, 85
- , low contrast 52
- Maxwell's equations 152
- Mechanical seal 24
- Membranes 40
- Michelson interferometer 94, 128
- Microdefects 145, 148-150
- Microelectronics 1
- Microfocus 26
- Microinclusions 169, 185
- Microscopy of biological objects 82
- Mirrors 87, 108, 109, 132
- Misorientation boundaries 184
- , effective 161
- Mixed Bragg-Laue case 126
- - - interferometer 97
- Mobilities of dislocations 194
- Moiré technique 129, 130
- topograph 129
- Molecular beam epitaxy 3
- Monochromator, Ge/Si 134
- Multilayer coatings 87
- Multilevel devices 64
- Multiple-stage imaging 206, 209
- Mylar 42

- NaF 135
- Neutron, charge and moment of 136
- , coherent scattering length 128
- , dipole moment 133
- , gyromagnetic ratio 138
- , interaction with magnetic field 137
- , - with matter 93
- , interferometer 93, 96, 134, 136
- , phase shift 139

- Neutron, properties 133
 -, thermal 95, 131
 - topography 150, 152
 Neutrons 145
 Noise 49
 Non-absorption case 98
 Noninterfering contributions 128
 Nonplanar waves 111
 Nuclear interaction 93
- Operator scheme of interferometry 96
 -, unitary 95
 Optical alignment 67
 Organic films 41
- Parallel exposure 76
 Parseval's theorem 163
 Pattern generator 86
 Patterning techniques 74
 PbO vidicon 199, 201
 Pendellösung 93, 102, 117, 146, 158, 159, 162,
 164, 167, 176, 184
 Penumbral blurring 36
 Phase contrast topography 136
 Phonon, wave vector 111
 Planar defects 148, 177
 -, -, topography 148
 Planck's constant 139
 Plane wave theory 99, 152
 Plasma etching 71
 PMMA 38, 53, 56, 57, 59
 Poisson distribution 50
 Polarization 99, 101, 138
 Polythitic interferometer 122
 Positional stability 122
 Poynting vector 156
 Process variables 74
 Processing 70
 Projection topograph 147, 149
 Propagation equation 152, 154
 - of waves in a deformed crystal 166
 Proximity effects 84
 Pseudopotential 99
 Pulsed X-rays 31
- Radiation damage 83, 86
 Ray tracing 118
 Real resists 52
 Reciprocal space 3
 Reflection range 101
 topography 146
 Reflectivity, integrated 116
 Resist, chain scission 54
 - characterization 53
 - contrast 55, 57
 -, crosslinking of 54
 -, ideal 49
 -, normalized remaining 56
 -, - thickness 61
 - profile 56
 -, resolution of 59
 -, sensitivity 52, 55
 -, sensitized 60
 - thickness curve 61
 Resists, properties of 63
 -, real 52
 Resolution 50, 52, 59, 82
 - of Camera 201, 202
 -, spatial 193
 - in topography 211
 Resonators 97, 129
 Rocking curve 115
 Rotary anode 10, 15, 22, 25, 44, 207, 216
- Quartz 97, 148, 206
- Scanning electron microscope 82
 Scattering factors 128, 133
 - length 133
 - potential 99
 Schwinger interaction 93
 Secondary electrons 44
 Section topography, dislocation image 169,
 173
 -, -, images of planar defects 177
 - -, intensity distribution 163
 Self-aligning 68
 Sensitivity 52, 54
 Seal, magnetic fluid 24
 -, mechanical 24
 -, oil 24
 Semiconductor devices 1, 80
 Separation $K\alpha_1/K\alpha_2$ 210
 Shock wave 31
 Shot noise 49
 Signal-to-noise ratio 194, 198, 205, 208
 Si 40, 81, 97, 130, 132, 135, 148, 176, 182, 197,
 199, 203, 205, 206, 208, 212
 Si:Fe 150
 Silicon, ion implanted 213
 - membranes 40, 41
 Si_3N_4 41
 Si:O 148
 SiO_2 41
 Single-stage imaging 196
 Single waver exposure 77
 Skew-symmetric interferometer 123
 Soft X-rays 27, 44, 86
 - -, generator 27
 Space charge 43

- Spatial resolution 193
- Spherical wave theory 98, 160, 163
- Spinor rotation 137
- Sputter etching 71
- Square wave modulation transfer function 202
- Stability, positional of interferometer 122
 - of wafer 64
- Stacking fault 145, 177, 178, 182
- Stationary phase method 104, 106
 - targets 12
- Stereo topography 147
- Storage of TV frames 202
 - ring, 47, see also synchrotron
- Strain fields 130
 - gradients 166, 185
- Strains 145
- Striations 145, 199
- Structuring of solids 1
- Substrate materials 40
- Surface damage 169
 - orientation, asymmetry 101
- Susceptibility 99, 152, 159
 - , imaginary part 159
- Synchrotron radiation 2, 45, 83, 128, 133, 201, 216

- Thermal neutrons 131
 - stress 17, 199
- Three-beam case interferometer 126
- Tic-point, migration 129
- Tic-points 129, 155, 157, 164, 178, 179
- Tolerances, geometrical of interferometers 119, 121
- Topography, detectors 216
 - , direct beam 150
 - , double crystal 149
 - , field of view 215
 - , horizontal resolution 211
 - , intensity distribution 163
 - , kinematical image 150
 - , limited projection 149
 - , live 191
 - , magnification 216
 - , Moiré 129, 131
 - , neutron 145, 150, 152
 - , on rocking curve flank 150
 - , phase contrast 136
 - , principles of 146
 - , section 145
 - , stereo 147
 - , traverse 147
 - , vertical resolution 212
- Transfer function 202

- Transition factor 111, 112
- Translation of interferometer components 110
 - stage 132
- Transmission, anomalous 159
- Traverse topograph 147
- Triglycine sulphate 168, 172
- Triple Laue-case interferometer 97, 114, 123
- Twin boundary 145, 182, 183
- Two-crystal version of interferometer 97
- TV system 194

- Unitary operator 95
- Unpolarized nuclei 133

- Vacuum seal 10, 24
- Vertical resolution of topography 212
- Vibrating crystal 111, 112
- Video display 28
- Vidicon 195, 199, 201
- Virtual focal point 179

- Water 135
- Wave fields 152, 155, 166
 - – in a deformed crystal 166
- Wavelength selection 36
- Waves, nonplanar 111
- Web crystals 206, 209
- Wet chemical etching 70
- Wilson seal 11

- X-ray alignment 67
 - fringe processing 132
 - holography 97
 - interferometry 93
 - lasers 4, 129
 - lithographics systems 75
 - lithography 35
 - mask 39
 - microscopy 2
 - resists 47, 63
 - resonators 97
 - Raman scattering 2
 - sources 42
 - topography 191
 - vidicon 195
 - yield 18

- Yields 18

- ZnS 207
- Zn₂SiO₄ 212
- Zone plates 86