

Contents

1	Bases of Synchrotron Radiation, Light Sources, and Features of X-Ray Scattering Beamlines	1
	M.C. García-Gutiérrez and D.R. Rueda	
1.1	Introduction	1
1.2	Synchrotron Radiation Source	5
1.3	Main Components of a Synchrotron Radiation Source	8
1.4	Characteristics of the Synchrotron Light	10
1.5	Use of Insertion Devices to Improve the Synchrotron Radiation	13
1.6	Experimental Beamline	16
1.7	Synchrotron Radiation Facilities	18
	References	20
2	Scattering of Soft Condensed Matter: From Fundamentals to Application	23
	N. Stribeck	
2.1	Introduction	23
2.2	Experiment Geometry and Reciprocal Space	24
2.3	Materials Structure and Scattering Pattern	29
2.4	Options for an Analysis of the Scattering Intensity	31
2.5	From the Mathematical Laboratory of Scattering	34
2.6	Application to Materials with Fiber Symmetry	41
	References	58
3	A Basic Introduction to Grazing Incidence Small-Angle X-Ray Scattering	61
	P. Müller-Buschbaum	
3.1	Introduction	61
3.2	General Principles	63
3.3	Simplifications	82
3.4	Summary and Outlook	83
3.5	Appendix – Critical Angles of Polymers	85

References	86
4 Fundamentals of Soft Condensed Matter Scattering and Diffraction with Microfocus Techniques	91
C. Riekkel, M. Burghammer, R. Davies, R. Gebhardt, and D. Popov	
4.1 Introduction	91
4.2 Examples for μ -SAXS/WAXS Experiments	92
4.3 Techniques, Instrumentation, and Data Analysis	94
4.4 Radiation Damage Issues	100
4.5 How to Access 3D Information?	101
References	102
5 The Use of Scattering and Spectroscopic Synchrotron Radiation Methods in Materials Science	105
W. Bras	
5.1 Introduction	105
5.2 New Techniques	109
5.3 Some Examples	111
5.4 Conclusions	130
References	131
6 Synchrotron Small-Angle X-Ray Scattering Studies of Colloidal Suspensions	133
T. Narayanan	
6.1 Introduction	133
6.2 General Principles	134
6.3 Applications of SAXS Methods	144
6.4 Summary and Outlook	154
References	155
7 Applications of Synchrotron X-Ray Diffraction to the Study of the Phase Behavior in Liquid Crystalline Polymers	157
E. Pérez, J.P. Fernández-Blázquez, A. Martínez-Gómez, A. Bello, M.L. Cerrada, R. Benavente, and J.M. Pereña	
7.1 Introduction	158
7.2 Mesophase Structures and Diffraction Profiles	159
7.3 Techniques for the Analysis of the Phase Behavior	161
7.4 Synchrotron X-Ray Diffraction Studies of the Phase Behavior in Liquid Crystalline Polymers	162
References	181
8 Structural Analysis of Biological and Technical Nanocomposites by X-Ray Scattering	183
P. Nawani, H. Zhou, B. Chu, C. Burger, and B.S. Hsiao	
8.1 Introduction	184
8.2 Theoretical Background	187
8.3 SAXS Analysis of Collagen/Mineral Nanocomposites	190

8.4	Analysis of Polymer–Organoclay Nanocomposites	193
8.5	Conclusions	196
	References	197
9	Application of Non-crystalline Diffraction with Microfocus to Carbon Fibres	199
	D. Cazorla-Amorós, D. Lozano-Castelló, and M. Müller	
9.1	Introduction	199
9.2	Examples of Applications of Microbeam Diffraction and MicroSAXS to Carbon Fibres	200
9.3	Concluding Remarks	214
	References	215
10	Simultaneous Calorimetric, Dielectric, and SAXS/WAXS Experiments During Polymer Crystallization	217
	A. Wurm, A.A. Minakov, and C. Schick	
10.1	Introduction	218
10.2	Experimental	221
10.3	Results and Discussion	225
10.4	Summary	228
	References	229
11	Discovering New Features of Protein Complexes Structures by Small-Angle X-Ray Scattering	231
	C.L.P. Oliveira, T. Vorup-Jensen, C.B.F. Andersen, G.R. Andersen, and J.S. Pedersen	
11.1	Introduction	232
11.2	Experimental Setup	232
11.3	Basic SAXS Theory	237
11.4	Applications	239
11.5	Conclusions	243
	References	244
12	Protein Shape and Assembly Studied with X-Ray Solution Scattering: Fundamentals and Practice	245
	R.M. Buey, P. Chacón, J.M. Andreu, and J. Fernando Díaz	
12.1	Introduction	245
12.2	Protein SAXS Basics	246
12.3	Applications of SAXS for Structural Analysis of Proteins	255
	References	262
13	Diagnosis Applications of Non-Crystalline Diffraction of Collagen Fibres: Breast Cancer and Skin Diseases	265
	M. Costa, N. Benseny-Cases, M. Cócera, C.V. Teixeira, M. Alsina, J. Cladera, O. López, M. Fernández, and M. Sabés	
13.1	Introduction	266
13.2	SAXS Applied to Breast Cancer Diagnosis	268

13.3	SAXS Applied to Skin Characterisation	271
13.4	Conclusions	278
	References	278
14	X-Ray Diffraction from Live Muscle Fibres	281
	A. Svensson, J. Bordas, and F.B. de la Cuesta	
14.1	Introduction	282
14.2	Instrumentation	283
14.3	Muscle Structure	286
14.4	X-Ray Diffraction	289
14.5	Materials and Methods	296
14.6	Myosin-Based Meridional Reflections	297
14.7	Conclusions	312
	References	312
	Index	315