

# Contents

<b>1</b>	<b>Bases of Synchrotron Radiation, Light Sources, and Features of X-Ray Scattering Beamlines</b> .....	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
<b>2</b>	<b>Scattering of Soft Condensed Matter: From Fundamentals to Application</b> .....	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
<b>3</b>	<b>A Basic Introduction to Grazing Incidence Small-Angle X-Ray Scattering</b> .....	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
<b>4 Fundamentals of Soft Condensed Matter Scattering and Diffraction with Microfocus Techniques</b> .....	91
C. Riekkel, M. Burghammer, R. Davies, R. Gebhardt, and D. Popov	
4.1 Introduction .....	91
4.2 Examples for $\mu$ -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
<b>5 The Use of Scattering and Spectroscopic Synchrotron Radiation Methods in Materials Science</b> .....	105
W. Bras	
5.1 Introduction .....	105
5.2 New Techniques .....	109
5.3 Some Examples .....	111
5.4 Conclusions .....	130
References .....	131
<b>6 Synchrotron Small-Angle X-Ray Scattering Studies of Colloidal Suspensions</b> .....	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
<b>7 Applications of Synchrotron X-Ray Diffraction to the Study of the Phase Behavior in Liquid Crystalline Polymers</b> .....	157
E. Pérez, J.P. Fernández-Blázquez, A. Martínez-Gómez, A. Bello, M.L. Cerrada, R. Benavente, and J.M. Perea	
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
<b>8 Structural Analysis of Biological and Technical Nanocomposites by X-Ray Scattering</b> .....	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
<b>9</b>	<b>Application of Non-crystalline Diffraction with Microfocus to Carbon Fibres</b>	<b>199</b>
	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
<b>10</b>	<b>Simultaneous Calorimetric, Dielectric, and SAXS/WAXS Experiments During Polymer Crystallization</b>	<b>217</b>
	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
<b>11</b>	<b>Discovering New Features of Protein Complexes Structures by Small-Angle X-Ray Scattering</b>	<b>231</b>
	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
<b>12</b>	<b>Protein Shape and Assembly Studied with X-Ray Solution Scattering: Fundamentals and Practice</b>	<b>245</b>
	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
<b>13</b>	<b>Diagnosis Applications of Non-Crystalline Diffraction of Collagen Fibres: Breast Cancer and Skin Diseases</b>	<b>265</b>
	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**