

# Contents

<b>Part I Methodology</b>	1
<b>1 Lipofuscin of the Retinal Pigment Epithelium</b>	3
<i>Janet R. Sparrow</i>	
1.1 Introduction	3
1.2 The Source of RPE Lipofuscin	3
1.3 Characteristics of Known RPE Lipofuscin Pigments	4
1.4 Adverse Effects of RPE Lipofuscin	8
1.5 Modulators of RPE Lipofuscin Formation	9
1.6 Summary	10
References	11
<b>2 Origin of Fundus Autofluorescence</b>	17
<i>François Delori, Claudia Keilhauer, Janet R. Sparrow, Giovanni Staurenghi</i>	
2.1 Introduction	17
2.2 Spectrofluorometry of Fundus Autofluorescence (FAF)	18
2.3 Imaging of FAF	18
2.4 Influence of Crystalline Lens Absorption	19
2.5 Spatial Distribution of FAF	19
2.6 Spectral Properties of FAF	21
2.7 Age Relationship of FAF	23
2.8 Near-Infrared FAF	24
2.9 Conclusions	25
References	25
<b>3 Fundus Autofluorescence Imaging with the Confocal Scanning Laser Ophthalmoscope</b>	31
<i>Steffen Schmitz-Valckenberg, Fred W. Fitzke, Frank G. Holz</i>	
3.1 The Confocal Scanning Laser Ophthalmoscope (cSLO)	31
3.2 FAF Imaging with the cSLO	31
3.3 Combination of cSLO Imaging with Spectral-Domain Optical Coherence Tomography	34
References	36

<b>4</b>	<b>How To Obtain the Optimal Fundus Autofluorescence Image with the Confocal Scanning Laser Ophthalmoscope .....</b>	37
	<i>Steffen Schmitz-Valckenberg, Vy Luong, Fred W. Fitzke, Frank G. Holz</i>	
4.1	Basic Considerations .....	37
4.2	Reflectance Before Autofluorescence Imaging .....	37
4.3	Image Alignment and Calculation of Mean Image .....	39
4.4	Normalizing of FAF Image .....	39
4.5	Standardized Protocol for FAF Imaging .....	40
4.6	Pitfalls .....	41
4.6.1	Focus .....	41
4.6.2	Detector Sensitivity .....	41
4.6.3	Distance of Laser Scanning Camera to Cornea .....	43
4.6.4	Illumination .....	43
4.6.5	Image Orientation .....	43
4.6.6	Eye Movements .....	44
4.7	Media Opacities .....	45
	References .....	47
<b>5</b>	<b>Autofluorescence Imaging with the Fundus Camera .....</b>	49
	<i>Richard F. Spaide</i>	
5.1	Introduction .....	49
5.2	Imaging Autofluorescence with a Fundus Camera .....	49
5.3	Differences Between the Autofluorescence Images Taken with a Fundus Camera and a cSLO .....	51
	References .....	53
<b>6</b>	<b>Macular Pigment Measurement—Theoretical Background .....</b>	55
	<i>Sebastian Wolf, Ute E.K. Wolf-Schnurribusch</i>	
6.1	Introduction .....	55
6.2	Functional and Physiological Properties of Macular Pigment .....	55
6.3	Detection of Macular Pigment .....	56
6.4	Measurement of Macular Pigment Density Using a cSLO .....	58
	References .....	59
<b>7</b>	<b>Macular Pigment Measurement—Clinical Applications .....</b>	63
	<i>Frederik J.G.M. van Kuijk, Daniel Pauleikhoff</i>	
7.1	Introduction .....	63
7.2	Variability of Macula Pigment Distribution .....	63
7.3	Genetic and Environmental Factors of Macular Pigment Distribution .....	65
7.4	Macular Pigment Distribution: Effect of Supplementation .....	66
7.5	Summary .....	67
	References .....	68

---

<b>8</b>	<b>Evaluation of Fundus Autofluorescence Images</b>	71
	<i>Frank G. Holz, Monika Fleckenstein, Steffen Schmitz-Valckenberg, Alan C. Bird</i>	
<b>Part II Clinical Application</b>		77
<b>9</b>	<b>Macular and Retinal Dystrophies</b>	79
	<i>Andrea von Rückmann, Fredrick W. Fitzke, Steffen Schmitz-Valckenberg, Andrew R. Webster, Alan C. Bird</i>	
	References	80
<b>10</b>	<b>Discrete Lines of Increased Fundus Autofluorescence in Various Forms of Retinal Dystrophies</b>	121
	<i>Monika Fleckenstein, Hendrik P.N. Scholl, Frank G. Holz</i>	
10.1	Introduction	121
10.2	Different Orientation of Lines of Increased FAF	121
10.2.1	Orientation Along Retinal Veins	121
10.2.2	Ring Shape	122
10.3	Functional Correlate of Lines/Rings of Increased FAF	122
	References	124
<b>11</b>	<b>Age-Related Macular Degeneration I—Early Manifestation</b>	133
	<i>Steffen Schmitz-Valckenberg, Hans-Martin Helb, Almut Bindewald-Wittich, Samantha S. Dandekar, Frank G. Holz</i>	
11.1	Background	133
11.2	FAF Findings	133
11.3	Classification of FAF Patterns in Early AMD	135
11.4	Reticular Drusen	135
	References	136
<b>12</b>	<b>Age-Related Macular Degeneration II—Geographic Atrophy</b>	147
	<i>Steffen Schmitz-Valckenberg, Almut Bindewald-Wittich, Monika Fleckenstein, Hendrik P.N. Scholl, Frank G. Holz</i>	
12.1	Background	147
12.2	Detection and Quantification of Atrophy	147
12.3	Correlation of FAF Findings with Functional Impairment	148
12.4	Classification of FAF Patterns in Geographic Atrophy	149
12.5	FAF Patterns and Progression Over Time	149
	References	151

<b>13</b>	<b>Age-Related Macular Degeneration III—Pigment Epithelium Detachment</b>	165
	<i>Felix Roth, Frank G. Holz</i>	
13.1	Introduction	165
13.2	FAF Findings	165
<b>14</b>	<b>Age-Related Macular Degeneration IV—Choroidal Neovascularization (CNV)</b>	179
	<i>Samantha S. Dandekar, Alan C. Bird</i>	
14.1	Introduction	179
14.2	FAF Findings in Early CNV	180
14.3	FAF Findings in Late-Stage CNV	180
14.4	FAF Findings in Relation to CNV Classification	180
14.4.1	Classic CNV	181
14.4.2	Occult CNV	181
14.5	RPE Tears	182
	References	182
<b>15</b>	<b>Idiopathic Macular Telangiectasia</b>	199
	<i>Peter Charbel Issa, Hendrik P.N. Scholl, Hans-Martin Helb, Frank G. Holz</i>	
15.1	Introduction	199
15.2	FAF in Type 1 Idiopathic Macular Telangiectasia	199
15.3	FAF in Type 2 Idiopathic Macular Telangiectasia	200
	References	200
<b>16</b>	<b>Chorioretinal Inflammatory Disorders</b>	207
	<i>Richard F. Spaide</i>	
16.1	Introduction	207
16.2	Acute Posterior Multifocal Placoid Pigment Epitheliopathy	208
16.3	Acute Syphilitic Posterior Placoid Chorioretinitis	209
16.4	Multifocal Choroiditis and Panuveitis	210
16.5	Acute Zonal Occult Outer Retinopathy	212
16.6	Birdshot Chorioretinopathy	213
	References	214
<b>17</b>	<b>Autofluorescence from the Outer Retina and Subretinal Space</b>	241
	<i>Richard F. Spaide</i>	
17.1	Introduction	241
17.2	Animal Models	242
17.3	Histopathology	243
17.4	Ocular Imaging	244

---

17.5	Central Serous Chorioretinopathy .....	245
17.6	Adult-Onset Foveomacular Vitelliform Dystrophy .....	247
17.7	Choroidal Tumors .....	248
17.8	Cystoid Macular Edema .....	248
17.9	Choroidal Neovascularization .....	249
17.10	Optic Pit Maculopathy .....	249
17.11	Tractional Detachment of the Macula .....	250
17.12	Persistent Subretinal Fluid after Retinal Reattachment Surgery .....	250
17.13	Acute Exudative Polymorphous Vitelliform Maculopathy .....	251
17.14	Vitelliform Macular Dystrophy .....	252
17.15	Summary .....	255
	References .....	255
<b>18</b>	<b>Miscellaneous .....</b>	<b>313</b>
	<i>Frank G. Holz, Steffen Schmitz-Valckenberg, Monika Fleckenstein, Richard F. Spaide</i>	
18.1	Macular Holes .....	313
18.2	Foveal Hypoplasia .....	313
18.3	Chloroquine Maculopathy .....	314
18.4	Optic Disc Drusen .....	314
18.5	Pseudoxanthoma Elasticum .....	314
18.6	Bilateral Diffuse Uveal Melanocytic Proliferation .....	315
18.7	Congenital Hypertrophy of the Retinal Pigment Epithelium .....	315
	References .....	315
<b>Part III Perspectives in Imaging Technologies</b>	.....	<b>329</b>
<b>19</b>	<b>Perspectives in Imaging Technologies .....</b>	<b>331</b>
	<i>Steffen Schmitz-Valckenberg, Frank G. Holz, Fred W. Fitzke</i>	
19.1	Introduction .....	331
19.2	Image Acquisition and Processing .....	331
19.3	Quantification of the FAF Signal .....	332
19.4	Color Imaging of the Fundus Using the cSLO .....	334
19.5	Metabolic Mapping of Additional Fluorophores .....	334
19.6	Adaptive Optics .....	335
19.7	Two-Photon Excited Fluorescence Imaging .....	335
	References .....	337
<b>Subject Index</b>	.....	<b>339</b>