

Contents

Contents	7
List of Figures	9
1 Theory and Instrumental Details	13
1.1 Principle of Ellipsometry	13
1.1.1 Maxwell Equations	14
1.1.2 Mathematical Representation of Polarization	15
1.1.3 Jones Vector and Jones Matrix Formalism	16
1.1.4 Photometric Ellipsometry	17
1.2 Modelling Ellipsometric Spectra	18
1.2.1 Reflection on a Bulk System - the Fresnel Coefficients	18
1.2.2 Layered systems	20
1.2.2.1 Ambient/Film/Substrate system	20
1.2.2.2 Stratified planar isotropic systems	21
1.2.3 Effective Medium Approximation	23
1.3 Numerical Optimization	24
1.3.1 L-BFGS-B	25
1.3.2 Differential Evolution	26
1.3.3 Simulated Annealing	28
1.4 Instrumental Details	30
2 Investigated Biological Systems: Skin and Skin Appendages	33
2.1 Nail	33
2.2 Skin	35
2.3 Hair	37
3 Experiments	41
3.1 Studies on Allium Cepa	41
3.2 Hydration Studies on Human Fingernails	43
P I Hydration dynamics of human fingernails: An ellipsometric study .	56
P II Spectroscopic ellipsometry on biological materials — investigation of hydration dynamics and structural properties	61

3.3	In-Vivo Study on Human Skin	61
	P III In-vivo spectroscopic ellipsometry measurements on human skin . .	75
3.4	Structural Studies on Human Hair	75
	3.4.1 Single Hair Measurements	75
	3.4.2 Measurements on Hair Strands	76
	3.4.3 A Dielectric Model of the Hair	85
	P IV Structural investigations of human hairs by spectrally resolved ellip- sometry	103
4	Summary	103
5	Conclusions and Outlook	105
	Bibliography	109
	Acknowledgements	113
A	A Programmer's Overview over ElliPy2	115