

Contents

1	Introduction and Motivation	1
2	Related Works and Basic Considerations	5
2.1	Profilometry	5
2.1.1	Atomic Force Microscopy	7
2.1.2	Confocal Laser Scanning Microscopy	7
2.1.3	Digital Holographic Microscopy	9
2.1.4	Phase-shifting Interferometry	11
2.1.5	Coherence Scanning Interferometry	12
2.1.6	Low-coherence Interferometry	13
2.2	Polymer Cross-linking Characterization	16
2.2.1	Soxhlet-type Extraction	17
2.2.2	Differential Scanning Calorimetry	18
2.2.3	Dynamic Mechanical Analysis	18
2.2.4	Spectroscopy-based Methods	20
2.2.5	Low-coherence Interferometry and Other Optical Methods	20
2.2.6	Spatially-resolved Approaches	21
2.3	Film Thickness Measurement	22
2.3.1	Spectral Reflectometry	23
2.3.2	Spectroscopic Ellipsometry	24
2.4	Material dispersion	26
2.4.1	Thermo-optic coefficient	29
2.4.2	Photo-elastic influences	32
2.4.3	Characterization of dispersion	33

3	Surface Profilometry	39
3.1	Experimental Setup	39
3.2	Measurement Range and Resolution	40
3.3	Signal Formation and Analysis	52
3.3.1	Fitting of Oscillating Data	52
3.3.2	Frequency Analysis	54
3.3.3	Two-Stage Fitting	55
3.3.4	Error Estimation of the Data Processing	57
3.4	Two-Dimensional Approach and Characterization	61
3.4.1	Height Standard Evaluation	63
3.4.2	Repeatability and Resolution Characterization	65
3.4.3	Edge Effects	69
3.4.4	Roughness Evaluation	72
3.4.5	High-Dynamic Range Measurements	76
3.4.6	Dual-Channel Approach	78
3.5	Areal Measurement Approaches	83
3.5.1	Translation-Based Areal Information	83
3.5.2	Alternative Spectral Encoding for Areal Measurements	86
4	Polymer Characterization	89
4.1	Temporal Approach	90
4.2	Scan-free Approach	98
4.2.1	Wrapped-phase Derivative Evaluation (WPDE)	98
4.2.2	Spatially-resolved Approaches	101
4.3	Influences and Limitations	106
4.3.1	Error Parameters of the Temporal Approach	111
4.3.2	Error Propagation in WPDE	112
5	Thin-film Characterization	123
5.1	Setup Considerations	123
5.2	Characterization of Thin-films on Bulk Substrates	126
5.3	Characterization of Flexible Substrate Materials	127
6	Conclusion	131
	Glossary	137
	Publications	139
	Bibliography	143