

Table of Contents

Abstract.....	i
Zusammenfassung.....	iii
1 Introduction	1
1.1 Motivation and objectives	1
1.2 Outline of the thesis	3
1.3 The structure of wood.....	4
1.3.1 The molecular level.....	4
1.3.2 The ultrastructural level	5
1.3.3 Lamella structure of the S ₂ -layer	7
1.3.4 The microscopic level.....	10
1.3.5 The macroscopic level.....	12
1.4 Challenges of wood as an engineering material	13
1.4.1 Surface coating for UV protection.....	14
1.4.2 Surface modification for improved bonding	16
1.5 Surface characterization of wood cells.....	18
1.5.1 Sample specifications and preparation	18
1.5.2 Principle techniques used in wood research at the cell wall level	19
1.5.3 Mechanical characterization at the cell wall level	21
1.5.4 Atomic Force Microscopy	23
2 Publications.....	28
2.1 Nano-mechanical characterization of the wood cell wall by AFM studies: comparison between AC- and QI™ mode	30
2.2 A close-up view of the wood cell wall ultrastructure and its mechanics at different cutting angles by Atomic Force Microscopy studies	46
2.3 High-resolution adhesion mapping of the odd-even effect on a layer-by-layer coated biomaterial by Atomic-Force-Microscopy.....	69
2.4 Summary of the co-authored publication.....	87

2.5 About the influence of a water-based priming system on the interactions between wood and one-component polyurethane adhesive studied by Atomic Force Microscopy and Confocal Raman Spectroscopy Imaging	88
3 General Discussion and Conclusion	107
3.1 Wood cell wall characterization by QI™ mode in contrast to traditional techniques	107
3.1.1 Specific methodical aspects of applying QI™ mode on wood	110
3.2 Characterization of native cell walls by AFM	112
3.3 Characterization of modified wood cell walls and surfaces by AFM	113
3.3.1 Layer-by-layer coating characterization by adhesion force	113
3.3.2 Primer characterization by work of adhesion	114
4 Outlook	117
A Acknowledgements	120
B Curriculum Vitae	121
C Publications	122
5 Literature of Chapters 1,3 and 4	125
D Erklärung	137