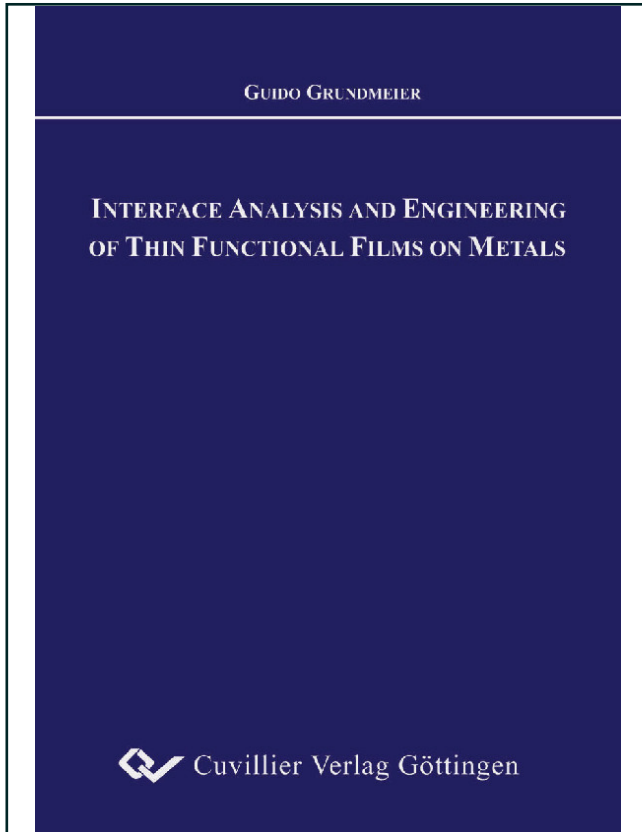




Guido Grundmeier (Autor)

Interface Analysis and Engineering of Thin Functional Films on Metals



<https://cuvillier.de/de/shop/publications/2031>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen, Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Contents:

1	Introduction	1
1.1	General introduction.....	1
1.2	Adhesion at polymer/metal and polymer/oxide interfaces.....	3
1.2.1	Aspects of materials science and physical chemistry.....	3
1.2.2	Basic principles of polymer to metal adhesion	5
1.2.3	Molecular understanding of adhesion at polymer/metal interfaces	7
1.2.4	Adhesion promoting bi-functional molecular layers on engineering metals.....	9
1.2.5	Conversion chemistry	12
1.2.6	Combustion and plasma enhanced chemical vapour deposition of thin films..	14
1.2.7	References.....	16
1.3	Mechanisms of de-adhesion at polymer/metal interfaces	20
1.3.1	Mechanisms of de-adhesion in humid environments.....	20
1.3.2	Mechanisms of corrosive polymer/metal de-adhesion.....	21
1.3.3	References.....	28
2	Objectives of the reported work	30
3	New advanced methods of interface analysis	32
3.1	A new height regulated Scanning Kelvin Probe.....	32
3.1.1	Principal aspects of the Scanning Kelvin Probe Technique in adhesion science	32
3.2	A new Height Regulated Scanning Kelvin Probe Blister Test (HR-SKP-BT) under potential control.....	35
3.2.1	Height regulation.....	35
3.2.2	The Height Regulated Scanning Kelvin Probe Blister Test (HR-SKP-BT).....	38
3.3	FTIR spectroscopic analysis of water transport in adhesive/metal joints	44
3.3.1	Introduction.....	44
3.3.2	Calculation of diffusion coefficients	46
3.3.3	Application of FTIR-transmission microscopy.....	47
3.3.4	Application of Scanning Attenuated Total Reflection FTIR-Spectroscopy	48
3.4	In-situ FT-IRRAS and Kelvin Probe Studies of Plasma Surface Chemistry	51
3.5	References	57
4	Adhesion and De-adhesion at Adhesive/Metal Interfaces	59
4.1	Adhesive/iron interfaces modified with bi-functional organosilanes	59

4.1.1	Introduction.....	59
4.1.2	Sample preparation.....	59
4.1.3	Optimisation of the joint stability with ultra thin layers.....	61
4.1.4	Kinetics of the interfacial degradation	64
4.1.5	Discussion.....	66
4.2	Bi-functional aminophosphonates at polymer/aluminium interfaces	68
4.2.1	Introduction.....	68
4.2.2	Sample preparation.....	69
4.2.3	Adsorbed monolayers from aqueous solutions	71
4.2.4	Interface enrichment of the aminophosphonates in model epoxy adhesives....	76
4.2.5	Corrosion resistance of modified interfaces	78
4.3	Diffusion of water and hydrated ions along adhesive/metal interfaces	80
4.3.1	FTIR-Measurements.....	80
4.3.2	SKP studies of ion transport along adhesive/metal interfaces	92
4.3.3	Conclusions.....	99
4.3.4	References.....	100
5	Ultra-thin conversion films on zinc alloy coatings.....	102
5.1	Introduction	102
5.2	Experimental.....	103
5.3	Surface film formation	105
5.3.1	Surface chemistry	105
5.3.2	Surface morphology	111
5.3.3	Electrochemical characterisation of the surface reactivity	112
5.4	Thin conversion film formation.....	118
5.4.1	Thin film chemistry	118
5.4.2	Microscopic studies of nucleation.....	126
5.4.3	Electrochemical properties of conversion film modified surfaces.....	129
5.5	Conclusions	135
5.6	References	138
6	Model Water Based Dispersion Coatings on Steel.....	140
6.1	Design and analysis of model systems	140
6.1.1	Synthesis and characterisation of model coating systems	142
6.1.2	Zn-phosphate adsorption on oxide covered iron surfaces	144
6.1.3	Interface layer formation at a coating/metal interface.....	149

6.1.4	Characterisation of latex particle monolayers on iron substrates	151
6.1.5	Conclusions.....	153
6.2	Correlation of coating composition and corrosion resistance	154
6.2.1	Synthesis of model multilayer pigmented coatings.....	155
6.2.2	Influence of pigment modifications on the interface chemistry	157
6.2.3	Barrier properties of pigment free and pigmented model coatings.....	160
6.2.4	Measurement of delamination kinetics of model coatings	163
6.2.5	Conclusions.....	171
6.2.6	References.....	172
7	Thin Plasma Polymer and Combustion CVD films.....	174
7.1	Introduction	174
7.2	Plasma modification of thin oxides on metals.....	175
7.2.1	In-situ FT-IRRAS Spectroscopy.....	175
7.2.2	Kelvin Probe measurements	177
7.3	Adhesion of organosilane plasma polymer films to oxide covered metals.....	179
7.3.1	In-situ IRRAS	179
7.3.2	Kelvin Probe Studies of Plasma Polymer/Oxide/Metal interactions	182
7.3.3	Ex-situ ToF-SIMS measurements	184
7.3.4	Conclusions.....	188
7.4	Combustion CVD of SiO ₂ films on zinc coated steel	189
7.4.1	Introduction.....	189
7.4.2	Nucleation and growth of thin SiO ₂ CCVD layers on galvanized steel.....	190
7.4.3	Conclusions.....	194
7.5	References	195
8	Functionality of Thin Plasma Polymer Films	197
8.1	Barrier properties of thin organosilicon plasma polymer films.....	197
8.1.1	Introduction.....	197
8.1.2	Chemical structure of thin plasma polymer barrier films.....	199
8.1.3	Film morphology.....	200
8.1.4	Electrochemical Impedance Spectroscopy	202
8.1.5	Conclusions.....	220
8.1.6	References.....	222
8.2	Tailored morphology and wettability of organosilane and fluorocarbon plasma polymer films.....	224

8.2.1	Introduction.....	224
8.2.2	Tailored morphology of organosilane plasma polymers for ultra-hydrophobic surfaces.....	226
8.2.3	Conclusions.....	236
8.2.4	Bi-layer and nanocomposite organosilicon-fluorocarbon plasma polymer films	237
8.2.5	Conclusions.....	248
8.2.6	References.....	249
9	SERS Active Substrates Prepared by Combined Plasma Polymerization and Physical Vapour Deposition.....	251
9.1	Introduction	251
9.2	Synthesis of the substrates.....	252
9.3	Characterisation of the Ag-coated SiO ₂ -plasma polymers as SERS active films ..	256
9.4	Conclusions	270
9.5	References	271
10	Overall Conclusions.....	273
11	Attachment – List of Symbols	276
11.1	Latin Symbols.....	276
11.2	Greek Symbols.....	277
11.3	Abbreviations.....	278