

Contents

Preface	xxi
Part 1: General Topics	1
1 Lip Biophysical Properties and Characterization Methods for Long-Wear Lipsticks	3
<i>Rebecca Barresi and I-Chien Liao</i>	
1.1 Introduction	4
1.2 Overview of Lip Anatomy & Lip Surface Properties	8
1.2.1 Lip Anatomy and Biophysical Properties	8
1.2.2 Surface Properties of the Lips	11
1.3 <i>In Vitro</i> Evaluation Methods for Lipsticks	17
1.3.1 Stability Testing of Lipstick Formulations	17
1.3.2 Physical Properties of Lipstick Formulations	18
1.3.2.1 Lipstick Hardness and Deposition	18
1.3.2.2 Lipstick Wear Assays	19
1.3.2.3 Lipstick Cohesion Test	21
1.3.2.4 Tack Testing	22
1.3.2.5 Thermal Analysis of Lipsticks	22
1.3.3 Visual Properties of Lipstick Formulations	23
1.3.3.1 Transfer Resistance Test	23
1.3.3.2 Gloss Measurement	24
1.4 Relation of <i>In Vitro</i> Analysis with Consumer Sensory Testing	25
1.5 Summary	28
Acknowledgements	29
References	29
2 Effect of Cosmetic Oils on Lipstick Structure and Its Deposit	35
<i>Momoko Suzumeji Shimizu, Yuta Nomura and Hy Si Bui</i>	
2.1 Introduction	35
2.2 Types of Natural Waxes, Their Physical Properties and Potential Applications	38

2.3	Factors Affecting Oil-Wax Structures	41
2.3.1	Factors Affecting Oil-Wax Structures: Wax Type	42
2.3.1.1	Non-Natural Waxes	42
2.3.1.2	Natural Waxes	43
2.3.2	Factors Affecting Oil-Wax Structures: Oil Polarity	44
2.3.3	Factors Affecting Oil-Wax Structures: Oil Viscosity	46
2.3.4	Factors Affecting Oil-Wax Structures: Cooling Rate	46
2.4	Study on Model Oil-Wax System Containing Polyethylene Wax	47
2.4.1	Materials	47
2.4.2	Measurements	48
2.4.2.1	Oil Viscosity	48
2.4.2.2	Oil Polarity by Relative Permittivity	48
2.4.2.3	Hardness of Lipsticks	48
2.4.2.4	Amount and Thickness of Lipstick Deposit on Bioskin	48
2.4.2.5	Wax Crystallization Study	49
2.4.2.6	Morphology of Wax Structure by SEM	50
2.5	Results and Discussion	50
2.5.1	Factors Affecting Lipstick Structure: Oil Viscosity	50
2.5.2	Factors Affecting Lipstick Structure: Oil Polarity	56
2.5.3	Factors Affecting Lipstick Structure: Wax Amount	60
2.5.4	Influence of Wax-Oil Lipstick Structure on its Deposition and Sensorial Perception	65
2.6	Summary	67
	Acknowledgement	68
	References	68
3	UV Curing of Nail Gels by Light Emitting Diode (LED) and Fluorescent (FL) Light Sources	73
	<i>Michael J. Dvorchak and Melanie L. Clouser</i>	
3.1	Introduction	73
3.2	UV Cure Chemistry	74
3.2.1	Initiation Reaction	74
3.2.2	Propagation Reaction	74
3.2.3	Chain Transfer Reaction	75
3.2.4	Termination Reaction	75
3.2.5	Photoinitiation	75
3.3	UV Cure Light Sources: Gallium-Doped Low-Wattage Long Wavelength Fluorescent (FL) Bulbs and Light Emitting Diodes (LEDs)	76

3.3.1	UV Light Spectrum	76
3.3.2	Matching the PI with the UV Light Source and Pigments Absorption/Transmission	77
3.4	UV Cure Oxygen Inhibition Issues	80
3.5	Special Considerations for the Use of UV Nail Gel Technology Due to Oxygen Inhibition	81
3.5.1	UV Nail Gel Cure Units: GA-FL and LED	81
3.5.2	UV Cure and Free Radical Oxygen Inhibition	81
3.5.3	Methods for Mitigating Oxygen Inhibition During UV Cure	82
3.5.4	Combinatorial Chemistry Technique Used to Mitigate Oxygen Inhibition for Low Energy UV-A Cure Resulting in Tack-Free Surfaces	84
3.6	How to Formulate a UV-A Cure Nail Gel	85
3.6.1	Formulating with (Meth) Acrylate Monomers	87
3.6.2	Formulating with the Proper Photoinitiator	87
3.7	Formulation of UV Nail Gels with 100% Solids UV Cure Oligomers and Monomers	89
3.7.1	Formulation of a UV Nail Gel Using a UV Cure Polyurethane Dispersion (UV-PUD)	90
3.7.2	Bio-Based UV Cured Nail Gel Materials	92
3.8	Human Nail Mechanical and Surface Free Energy Properties	92
3.9	Adhesion of UV Nail Gel to the Human Nail Plate	97
3.10	Removal of the UV Nail Gel From the Human Nail Plate	99
3.11	Alternative Uses of UV Cured Nail Gels as a Solution to Remedy Onychomycosis (Toenail Fungus)	99
3.12	UV Cured Nail Gel Safety	103
3.13	Prospects on UV Nail Gels	104
3.14	Summary	105
	Acknowledgements	105
	References	106
4	Rheological Properties Influence Tackiness, Application and Performance of Nail Polish/Lacquer Formulations	109
	<i>Leidy Nallely Jimenez, Carina D. V. Martínez Narváez, Chenxian Xu, Samantha Bacchi and Vivek Sharma</i>	
4.1	Introduction	110
4.2	Typical Ingredients of a Nail Polish Formulation	113
4.3	Rheological Response of Nail Polishes: Background	116
4.4	Methods for Characterizing Flow Behavior and Application to Nail Polishes	120

4.4.1	Shear Rheology Characterization and Tack Test	120
4.4.2	Application of Nail Paints: Brush Loading, Sagging, Nail Coating, and Dispensing	120
4.4.3	Extensional Rheology Characterization using Dripping-onto-Substrate (DoS) Rheometry	121
4.5	Materials: Ingredients of the Twelve Nail Polishes	122
4.6	Results and Discussion	123
4.6.1	Shear Rheology of Twelve Nail Polishes	123
4.6.2	Brush Loading and Sagging	129
4.6.3	Brush Application	130
4.6.4	Tack Test of Nail Lacquers	132
4.6.5	Dripping Nail Polish after Automated Brush Loading	134
4.6.6	Capillarity-Driven Pinching Dynamics and Extensional Rheology of Nail Polishes	135
4.7	Summary and Conclusions	141
	Acknowledgements	143
	References	143
5	Use of Advanced Silicone Materials in Long-Lasting Cosmetics	151
	<i>Amar B. Pawar and Benjamin Falk</i>	
5.1	Introduction	151
5.2	Adhesion to Skin	152
5.2.1	Skin as a Substrate for Adhesion	153
5.2.1.1	Structure of Human Skin	153
5.2.1.2	Skin Surface Physicochemical Properties	155
5.2.1.3	Skin Mechanical Properties	156
5.3	Formulation Strategies for Long-Lasting Cosmetics	157
5.3.1	Silicones in Cosmetic Products	158
5.3.2	Structure-Property Relation of Silicones	159
5.4	Advanced Silicone Materials for Long-Wear Cosmetics	160
5.4.1	Silicone MQ Resins in Color Cosmetics	161
5.4.1.1	MQ Resin Structure and Properties	161
5.4.1.2	MQ Resin as a Tackifier for Long-Wear Benefits	162
5.4.2	Silsesquioxane Resins in Long-Wear Cosmetics	168
5.4.3	Silicone Acrylate Copolymers in Long-Wear Cosmetics	169
5.4.3.1	Hybrid Silicone Acrylate Emulsion for Long-Wear Cosmetics	169
5.4.3.2	Solvent-Borne Hybrid Silicone Acrylate Copolymers	171

5.4.4	Ionic Functionalized Silicones for Long-Wear Cosmetics	173
5.5	Summary and Prospective Film-Formers for Long-Wear Cosmetics	174
	Acknowledgements	175
	References	175
Part 2: Surface Science Aspects		183
6	Advances in the Chemical Structure of the Hair Surface, Surface Forces and Interactions	185
	<i>Gustavo S. Luengo and Andrew J. Greaves</i>	
6.1	Introduction	185
6.2	Structure of Hair and the Outermost Surface	187
6.3	Chemical and Physical Modifications of the Hair Surface	187
6.4	Local Physico-Chemical Understanding of the Hair Surface	197
6.4.1	Mapping the Hair Surface Chemistry	198
6.4.2	Forces at the Surface of Hair	199
6.4.3	Interaction with Cosmetic Actives	202
6.5	Macroscopic Understanding of the Chemical Nature of the Hair Surface	203
6.6	Impact of the Hair Chemical Nature on Sensorial and Consumer Benefits	207
6.7	Prospects	208
6.8	Summary	208
	Acknowledgements	209
	References	209
7	AFM for Hair Surface Characterisation	215
	<i>Steven Breakspear, Bernd Noecker and Crisan Popescu</i>	
7.1	Hair Structure	215
7.2	Elements of AFM	217
7.2.1	Imaging - Topography	218
7.2.2	Force Measurements Using the AFM	220
7.2.2.1	Force Curves	221
7.2.2.2	Friction/Lateral Force	221
7.2.2.3	Elastic Theory and Nanoindentation	223
7.2.3	Requirements for Good Use of AFM - Calibration	224
7.3	The Use of AFM to Characterize the Hair Surface/Cuticle	227
7.3.1	Hair Dimensions and Considerations	227
7.3.2	Hair Surface Topography	229

7.3.3	Swelling	232
7.3.4	Friction	232
7.3.5	Adhesion	233
7.3.6	Charge Density Mapping - Tapping	235
7.3.7	Nanoindentation	236
7.4	Cosmetic Treatment (e.g. Bleaching) as Shown by AFM	237
7.5	Summary	240
	References	240
8	Atomic Force Microscopy (AFM) as a Surface Characterization Tool for Hair, Skin, and Cosmetic Deposition	245
	<i>Norbert Biderman and Hy Si Bui</i>	
8.1	Introduction	245
8.2	Atomic Force Microscopy Compared to Other Microscopy Techniques	246
8.3	The Principles of Atomic Force Microscopy	247
8.4	A Brief History of Hair Surface Investigation via Atomic Force Microscopy	249
8.5	Lateral Force Microscopy (LFM) of the Hair Surface	249
8.6	Adhesion at the Nanoscale via AFM	251
8.7	Elastic Modulus Measurement via AFM	254
8.8	Hair Studies via AFM	256
8.8.1	Nanomechanical Properties of the Hair Surface	256
8.8.2	Thickness of Deposited Films on the Hair Surface	257
8.8.3	Inferring the Film Thickness of Polymeric Formulations on the Hair Surface from Nanomechanical Measurements	258
8.8.4	Nanomechanical Analysis of a Commercial Long-Lasting Formulation on the Hair Surface	261
8.8.5	Nanoscale Characterization of the Impact of Commercial Hair Care Products on the Hair Fiber Interior	264
8.9	Skin Studies via AFM	265
8.9.1	Skin Surface Roughness and Skin Elastic Modulus	265
8.9.2	Effect of Cosmetic Deposition on Skin	266
8.9.3	Makeup Formulations from Two Competing Cosmetic Manufacturers on Non-Skin Substrate	267
8.9.4	Scaling Up Skin Cosmetics Formulations from Laboratory to Large-Scale Manufacturing	270
8.9.5	Interaction of Components in Skin Cosmetic Polymer Blends	272

8.10	Summary and Prospects	274
	References	276
9	Secondary Ion Mass Spectrometry as a Surface Analysis Method for Hair, Skin, and Cosmetics	279
	<i>Norbert Biderman</i>	
9.1	Introduction	279
9.2	Secondary Ion Mass Spectrometry (SIMS)	280
9.2.1	Fundamentals	280
9.2.2	Depth Resolution in SIMS: Key to Unlocking Topmost Surface Analysis	281
9.2.3	Static Versus Dynamic Secondary Ion Mass Spectrometry	282
9.2.4	Quantification in SIMS	284
9.2.5	SIMS Spectrometers	286
9.2.6	Primary and Analytical Ion Beams	290
9.3	Studying the Skin via TOF-SIMS	290
9.3.1	Imaging the Skin Barrier Properties	290
9.3.2	Chemical Changes Due to Skin Aging via TOF-SIMS	291
9.3.3	Penetration of Active Ingredients through the Human Skin	293
9.3.4	Fatty Acids as Penetration Enhancers as Evaluated with TOF-SIMS	294
9.4	Studying the Hair Via TOF-SIMS	295
9.4.1	Depth-Profiling the Hair Fiber Surface Directly via Ion Beam Sputtering	295
9.4.2	Identifying Unknown Chemistries on the Hair Fiber Surface with TOF-SIMS	297
9.4.3	Hair Crosslinking Materials Analysis via TOF-SIMS	298
9.4.3.1	A Kinetic Study of Thin Film Crosslinking on Silicon Wafer Substrate by TOF-SIMS Depth-Profiling	298
9.4.3.2	Detecting Long-Lasting, Shampooing-Resistant Crosslinked Thin Film on the Silicon Wafer Substrate	301
9.4.3.3	Long-Lasting, Shampooing-Resistant Crosslinked Material on the Hair Substrate	302
9.5	Future Prospects	305
	References	306

Part 3: Wetting and Adhesion Aspects	309
10 Surface Tensiometry Approach to Characterize Cosmetic Products in the Beauty Sector	311
<i>Davide Rossi and Nicola Realdon</i>	
10.1 Introduction	312
10.2 Peels	313
10.2.1 Characterization of the Formulations for Skin Peels	314
10.2.1.1 Surface Tension Approach to the Study of Chemical Peels for Face Skin Treatments	315
10.3 Face Masks	316
10.3.1 Constituents of Face Masks	317
10.3.1.1 Honey	317
10.3.1.2 Plant Oils	318
10.3.1.3 Egg White	318
10.3.1.4 Lavender Oil	320
10.3.1.5 Bentonite Clay	321
10.3.2 Surface Tensiometry Approach to the Study of Face Skin Masks	324
10.4 Serums	325
10.4.1 Surface Tensiometry Approach to the Study of Serums for Skin Applications	326
10.5 Eye Contour Creams	327
10.5.1 Surface Tensiometry Approach to the Study of Eye Contour Creams	329
10.6 Mascara	329
10.6.1 Characterization of Mascara	331
10.6.1.1 Surface Tensiometry Approach to the Study of Mascara	334
10.7 Eyeshadows	334
10.7.1 Surface Tensiometry Approach to the Study of Eyeshadows	336
10.8 Lipsticks	336
10.8.1 Surface Tensiometry Approach to the Study of Lipsticks	338
10.9 Foundation	339
10.9.1 Surface Tensiometry Approach to the Study of Face Skin Foundation	340

10.10	Anti-Aging Formulations	340
10.10.1	Surface Tension Approach to the Study of Anti-Aging Formulations	346
10.11	Summary	348
	Acknowledgement	349
	References	349
11	Spreading of Hairsprays on Hair	353
	<i>Yashavanth Kamath and Xuemin Chen</i>	
11.1	Introduction	353
11.2	Background on Interaction of Liquid Droplets with Fibers	354
11.2.1	Droplet Shapes in Relation to Fiber Diameter	356
11.2.2	Absorption of Liquids into Hair Assemblies	357
11.3	Materials and Experimental Methods	359
11.3.1	Materials	359
11.3.2	Methods	360
	11.3.2.1 Imaging System	360
	11.3.2.2 The Spreading Setup	361
11.4	Results and Discussion	361
11.4.1	Instability of Liquid Sprays on Hair	361
11.4.2	Synthetic and Hair Fiber Comparison	362
11.4.3	Holding Spray on One Hair Fiber	362
11.4.4	Holding Spray on Parallel Hair Fibers	363
11.4.5	Holding Spray on Crossing Hair Fibers	365
11.4.6	Spray on Three Crossing Hairs with a Load of 10 g	366
11.4.7	Holding Spray on One Bleached Hair Fiber	366
11.4.8	Holding Spray on Two Bleached Hair Fibers Parallel to Each Other	367
11.4.9	Holding Spray on Two Crossing Bleached Hair Fibers	370
11.5	General Observations on the Behavior of Holding Spray on Hair	370
11.6	Shine Spray on One Bleached Hair Fiber	373
11.7	Summary	375
	Acknowledgements	376
	References	376
12	Quantification of the Color Transfer from Long-Wear Face Foundation Products: The Relevance of Wettability	379
	<i>Joseph V. Badami and Hy Si Bui</i>	
12.1	Introduction	380

12.2	Experiments	381
12.2.1	Contact Angle Measurement	381
12.2.2.1	Foundation Transfer – <i>In Vitro</i>	382
12.2.2.2	Foundation Transfer – <i>In Vivo</i>	383
12.2.2.3	Image Analysis of Foundation Transfer	383
12.3	Results and Discussion	384
12.3.1	Contact Angle of Water on Polyester Substrate and Deposited Foundations	384
12.3.2	Contact Angle of Water on Bio Skin Substrate and Deposited Foundations	385
12.3.3	<i>In Vitro</i> Foundation Transfer from Polyester Application Substrate	386
12.3.4	<i>In Vitro</i> Foundation Transfer from Bio Skin Application Substrate	389
12.3.5	<i>In Vitro</i> Foundation Transfer – Impact of Foundation Shade	393
12.3.6	<i>In Vivo</i> Foundation Transfer	394
12.4	Summary and Perspectives	396
	Acknowledgments	397
	References	398
13	Interaction of Polyelectrolytes and Surfactants on Hair Surfaces. Deposits and their Characterization	401
	<i>Gustavo S. Luengo, Eduardo Guzman, Laura Fernández-Peña, Fabien Leonforte, Francisco Ortega and Ramon G. Rubio</i>	
13.1	Introduction	402
13.2	Hair Structure and Its External Surface	403
13.2.1	Hair Structure	403
13.2.2	Chemical Composition of Hair	406
13.2.3	Physico-Chemical Heterogeneity of the Cuticle	407
13.2.4	Hair Surface and its Interaction with Polyelectrolytes	412
13.3	Experimental Approaches for the Evaluation of the Deposition of Polyelectrolyte-Surfactant Systems onto Model Surfaces	413
13.3.1	Model Surfaces	413
13.3.2	Approaches for Quantitative Study of the Adsorption Process	415
13.3.3	A Typical Formulation of a Hair Conditioner	416
13.3.4	Bulk Behavior of Polyelectrolyte - Surfactant Mixtures	418

13.3.5	Polyelectrolyte-Surfactant Mixtures Adsorbed onto Solid Surfaces	423
13.3.6	Deposition Enhanced by Dilution	428
13.4	Theoretical Modelling of Polyelectrolyte-Surfactant Mixtures	430
13.4.1	Bulk Calculations	434
13.4.2	Surface Calculations	437
13.5	Prospects	441
13.6	Summary	441
	Acknowledgements	443
	References	443
14	Adhesion Aspect and Film-Forming Properties of Hydrocarbon Polymers-Based Lipsticks	451
	<i>Julien Portal, Xavier Schultze, Simon Taupin, Mireille Arnaud-Roux, Jerome Bonnard, Gregoire Naudin, Marc Hely, Hy Bui and Norbert Biderman</i>	
14.1	Introduction	452
14.2	Synthesis and Characterization of the Model Oil Compatible Polymers Dispersions	456
14.2.1	Chemical Composition of Non-Aqueous Polymer Dispersions	456
14.2.2	Physical Properties of Non-Aqueous Polymer Dispersions	456
14.2.2.1	Molecular Weight and Size of Polymer Aggregates	456
14.2.2.2	Glass/Vitreous Physical Properties of Polymer Dispersion - Differential Scanning Calorimetry (DSC)	459
14.2.2.3	Dynamic Mechanical Analysis (DMA)	460
14.2.2.4	Mechanical Properties of Films Cast from Polymer Dispersion	463
14.2.2.5	Morphology of NAD Samples by Transmission Electron Microscopy (TEM)	464
14.2.2.6	Surface Nanostructure of Films Cast from Polymer by Atomic Force Microscopy (AFM)	467
14.2.3	Thin Film Property and Adhesion Aspects	469
14.2.3.1	Surface Free Energy of NAD Films	469
14.2.3.2	Sebum and Water Resistance	473

14.3	NADs as Film-Formers for Long-Wear, Non-Transfer Lipstick	476
14.3.1	<i>In-Vitro</i> Evaluations	477
14.3.2	<i>In-Vivo</i> Evaluation	478
14.4	Summary and Prospects	480
	Acknowledgements	481
	Annex	482
	References	483
15	Factors Enhancing Adhesion of Color Cosmetic Products to Skin: The Role of Pigments and Fillers	487
	<i>Hubert Lam</i>	
15.1	Introduction	488
15.2	Overview of Pigments: Basic Physicochemical Considerations in Long-Wear Color Cosmetics	488
15.2.1	Pigments and Fillers in Long-Wear Color Cosmetics	489
15.2.1.1	Inorganic Pigments	489
15.2.1.2	Organic Pigments in Long-Wear Color Cosmetics	492
15.2.1.3	Factors Affecting Adhesion of Long-Wear Cosmetics	493
15.2.1.4	Importance of Pigment Wetting and Surface Treatment in a Color Dispersion in Long-Wear Cosmetics	496
15.2.1.5	Factors Affecting the Long-Lasting Color in Long-Wear Color Cosmetics: Dispersion of Treated Pigment	498
15.2.1.6	Factors Affecting Adhesion of Film-Formers: Functional Fillers	503
15.3	Factors Affecting Adhesion of Long-Wear Color Cosmetics	510
15.3.1	Long-Wear Liquid Foundation	510
15.3.2	Long-Wear Powders	516
15.3.2.1	Oil Absorbent and Water Absorbent Systems	516
15.3.2.2	Oil Repellent and Water Repellent Systems	518
15.3.3	Long-Wear Eye Shadow	519
15.3.4	Long-Wear and Transfer-Resistant Lipsticks	520
15.3.4.1	Pigments Used in Long-Wear Lip Products	521

15.3.4.2	Typical Fillers Used in Long-Wear Lipstick	523
15.3.5	Long-Wear Nail Polish	526
15.3.5.1	Conventional and UV Nail Polish	526
15.3.5.2	Water-Based Nail Polish	529
15.3.6	Long-Wear Mascara and Eyeliner	531
15.3.6.1	Pigments and Fillers Used in Long-Wear Mascara	531
15.3.6.2	Long-Wear Mascara	533
15.4	Summary and Prospects	534
	Acknowledgments	535
	References	535
16	Factors Affecting Cosmetics Adhesion to Facial Skin	543
	<i>Zhi Li and Hy Si Bui</i>	
16.1	Introduction	543
16.2	Factors Affecting Adhesion to Skin: Skin Substrate Properties	544
16.2.1	Skin Types	545
16.2.2	Surface Free Energy of Skin	545
16.2.3	Skin Young's Modulus	546
16.2.4	Skin Surface Roughness	547
16.2.5	Wetting and Spreading of Sebum and Sweat on Human Skin	548
16.3	Factors Affecting Adhesion to Skin: Formulation Components	549
16.3.1	Volatile Fluids	553
16.3.2	Treated Pigments	557
16.3.2.1	Silicone Surface Treatment	558
16.3.2.2	Amino Acid Surface Treatment	558
16.3.2.3	Silane Surface Treatment	560
16.3.2.4	Organo-titanate Surface Treatment	561
16.3.2.5	Hybrid Surface Treatment Chemistries	561
16.3.2.6	Surface Treatment Chemistry Affects Formulation Performance	562
16.3.3	Film-Formers	563
16.3.3.1	MQ Silicone Resins	565
16.3.3.2	T-Propyl Silicone Resin	567
16.3.3.3	Silicone Acrylates	568
16.3.3.4	MQ/Dimethicone Hybrids	569

16.3.4	Emulsifiers	570
16.3.4.1	Silicone Emulsifiers	570
16.3.4.2	Non-Silicone Emulsifiers	572
16.3.5	Fillers	572
16.4	Factors Affecting Adhesion to Skin: Combination of Film-Formers and Emulsifiers	573
16.4.1	Combination of MQ Resin and Silicone Emulsifier	576
16.4.2	Combination of Silicone Acrylate and Silicone Emulsifier	578
16.5	Summary and Prospects	580
	Acknowledgements	581
	References	581
17	Adhesion Aspect in Semi-Permanent Mascara	585
	<i>Christopher Pang and Hy Si Bui</i>	
17.1	Introduction	585
17.1.1	History of Mascara - Invention of the Mascara	585
17.1.2	Birth of the First Mascara	586
17.2	Structure of Eyelash and Eye Lid: An Overview	587
17.3	Types of Mascaras	589
17.4	Components in Mascara Formulations	593
17.5	Long-Wear Mascaras	596
17.5.1	One-Day Wear Mascara	596
17.5.2	Semi-Permanent Mascara (3 - 5-Day Wear)	596
17.5.3	Micropigmentation/Lash Tinting (30-Day Wear or Longer)	598
17.6	Evaluation Methods for Long-Wear Mascara	598
17.6.1	<i>In Vitro</i> Evaluation	598
17.6.2	<i>In Vivo</i> Evaluation by Expert Panels or Consumers	603
17.7	Factors Affecting Adhesion of Mascara on an Eyelash	604
17.7.1	Factors Affecting Adhesion of Mascara to Eyelash: Mascara Composition	605
17.7.1.1	Film-Formers	605
17.7.1.2	Critical Pigment Volume Concentration (CPVC)	613
17.7.2	Factors Affecting Adhesion of Mascara to Eyelash: Rheology of Mascara	614
17.7.2.1	Bulk Rheology of Long-Wear Mascara Formulation	614
17.7.2.2	Flow Property of Long-Wear Mascara Formulations	616

17.7.3	Factors Affecting Adhesion of Mascara to Eyelash: Surface Property of Mascara Deposit	619
17.7.3.1	Spreading and Wetting of Long-Wear Mascara on Eyelash	619
17.7.3.2	Deposition of Mascara on Eyelash	619
17.7.3.3	Internal Stress	620
17.7.3.4	Sebum/Sweat/Water Resistance	621
17.7.4	Factors Affecting Adhesion of Mascara to Eyelash: Mechanical Property of Mascara Deposit	622
17.8	Removability of Mascara	624
17.9	Summary and Prospects	628
	Acknowledgments	629
	References	629
18	Lipstick Adhesion Measurement	635
	<i>Caroline Richard</i>	
18.1	Introduction	635
18.2	Definition of Adhesion	641
18.3	Sensory Metrology: Subjective Methods	643
18.3.1	Self-Assessment Tests (Consumer Tests)	643
18.3.2	Tests with an Experimenter	644
18.3.3	Tests with an Instrumental Method	647
18.4	Mechanical Tests: Objective Methods	649
18.5	Correlation Between Sensory and Instrumental Tests	656
18.6	Summary	659
	Acknowledgments	659
	References	659
Index		663