Materials Experience

Fundamentals of Materials and Design

Edited by

Elvin Karana Owain Pedgley Valentina Rognoli

Amsterdam • Boston • Heidelberg • London • New York • Oxford Paris • San Diego • San Francisco • Singapore • Sydney • Tokyo

ELSEVIER

Butterworth-Heinemann is an imprint of Elsevier

BIOGRAPHY		XV
FOREWORD:	MATERIALS EXPERIENCE-FUNDAMENTALS OF MATERIALS	
AND DESIGN		xvii
PREFACE		xxiii
INTRODUCTI	ON TO MATERIALS EXPERIENCE	XXV
Section 1	Touched by Materials	
CHAPTER 1	Designing Material Experience Paul Hekkert and Elvin Karana	3
	From Product to Material Experience Types of experience Material aesthetics Emotions to materials Meanings of Materials Universal meanings Learned meanings	5 5 6 7 8 8 9
	How meanings change Designing Material Experience References	10 11 11
CHAPTER 2	Sensing Materials: Exploring the Building Blocks for Experiential Design Hendrik N.J. Schifferstein and Lisa Wastiels	15
	Relating Sensory Perception to Material Properties The Separate Roles of the Sensory Modalities in Material Experience How the Senses Work Together in Creating Experiences Sensory Dominance in Material Perception Integrating Vision and Touch: The Experience of Warmth	16 17 19 21 22

 \mathbf{V}

	Tactile warmth	22
	Color warmth	22
	Glossiness and roughness	23
	Comparing the contributions of vision and touch	23
	Associations and metaphorical meaning	24
	Conclusions	24
	References	24
CHAPTER 3	Tactile Aesthetics of Materials and Design	27
	Hengfeng Zuo, Tony Hope and Mark Jones	
	Tactile Perception of Materials	28
	Concept of texture	29
	Fundamentals of the sense of touch	30
	Dimensions and lexicons of tactile perception of materials	30
	Underlying Material Parameters	33
	Optimum Texture Design	34
	Conclusions	36
	Acknowledgments	36
	References	37
CHAPTER 4	The Sound and Taste of Materials	39
	Zoe Laughlin and Philip Howes	
	Sensoaesthetics	41
	A material-object methodology	42
	The Sound of Materials	42
	The objects	42
	The results	44
	The Taste of Materials	45
	The objects	45
	The experiments	46
	The results	47
	Conclusions	47
	Acknowledgments	48
	References	48
CHAPTER 5	Manipulating the Material Code: The Transformation of Material	
	Meaning in Contemporary Japanese Design	51
	Blaine Brownell	
	Sensory Manipulation	52
	Quasi-Mimesis	53

	Transliteration	55
	Repurposing	56
	Aggregation	58
	Conclusions	60
	Acknowledgments	61
	References	61
CHAPTER 6	The Immaterial of Materials <i>Jonathon Allen</i>	63
	Aesthetics and Ethics: Reflections on Personal Tastes and Material	
	Preferences	64
	At What Cost?	64
	At what price love? The noble and ignoble story of the wedding ring On valuing materials	66 67
	Changing perceptions: the curious story of cork and aluminum	68
	The embodied energy in aluminum	68
	Material and Manufacturing Legacies	68
	A painful legacy: from miracle material to mesothelioma	69
	Questioning color: I see red	70
	Conclusions	71
	References	72
Interview with	h Hella Jongerius	73
Interview with	n Ece Yalim	81
Section 2	Living with Materials	
CHAPTER 7	Materials and Social Sustainability Prabhu Kandachar	91
	Materials, Design, and Sustainability	91
	Materials Resources and Social Sustainability	94
	Natural Fibers	96
	Design and Development	98
	Conclusions	101
	References	101
CHAPTER 8	The "Material" Side of Design for Sustainability Carlo Vezzoli	105
	Introduction to the Product LCD Approach	107
	(Design) Environmental requirements	107
	-	

	The product life cycle phases The functional unit Life cycle assessment Product LCD strategies Material Selection in a Product LCD Approach Minimize material consumption Selecting low environmental impact materials	107 108 108 108 109 110 110
	Conclusions: Material Selection in DfS References	118 118 119
CHAPTER 9	Designing with Waste David Bramston and Neil Maycroft	123
	Use Less and Useless Use Refuse Emerging Beauty Conclusions Acknowledgments References	124 126 130 132 133 133
CHAPTER 10	Meaningful Stuff: Toward Longer Lasting Products Jonathan Chapman	135
	Altering the Parameters of Life Design is Darwinian Wake of Destruction Impermanence is Natural Materials and Meaning Toward Meaningful Stuff Conclusions References	136 137 138 140 141 141 142 143
CHAPTER 11	Toward a New Materials Aesthetic Based on Imperfection and Graceful Aging <i>Valentina Rognoli and Elvin Kaiana</i>	145
	Imperfection > Uniqueness Aging > Imperfection > Uniqueness Conclusions	147 150 152

CHAPTER 12	Conception and Realization of a Sustainable Materials Library <i>Jakki Dehn</i>	155
	The Formative Years	156
	Research into design and sustainable development of materials	157
	Hands-on Contact: The Value of a Physical Resource	159
	Materials selection	160
	Case Studies: The Importance of Collaboration	162
	Jedco (recycled plastic and recycled glass fiber, United Kingdom)	163
	Gifu Prefecture (recycled ceramics, Japan)	164
	Beleaf (banana fiber veneer, Monaco)	164
	Sustainable Materials Inspiration and Consultancy	165
	Conclusion	167
	Acknowledgments	167
	References	167
CHAPTER 13	Sustainable Multipurpose Materials for Design Sascha Peters	169
	Biobased Material Design	170
	Lightweight Material Design	172
	Smart Material Design	175
	Conclusion	179
	References	179
Interview with	Paolo Ulian	181
Interview with	Piet Hein Eek	189
Section 3	Futures through Materials	
CHAPTER 14	The Next Generation of Materials and Design	199
	Rob Thompson and Elaine Ng Yan Ling	
	Advanced Materials and Manufacturing	200
	Superlight	200
	Sustainable	202
	Shaping Future Material Experiences	203
	Designing materials	203
	Experienced materials	204
	Programmable materials	205
	Conclusions	206
	Acknowledgments	207
	References	207

CHAPTER 15	Nanomaterials in Design Daniel L. Schodek	209
	Nanomaterials in Nature and Art	210
	Nanomaterial Characteristics	210
	Product Forms and Applications	214
	A Closer Look at Unique Applications	217
	Conclusions—An Array of Opportunities	219
	References and Further Reading	220
CHAPTER 16	Sensing and Energy Harvesting Novel Polymer Composites Sybrand van dei Zwaga, Dan 4. van den Ende and Wilhelm Albert (Pim) Groen	221
	Syorana van det Zwaag, Dan A. van den Ende and Waneum Albert (1 im) Groen	001
	Introduction	221
	Brief Introduction to Piezoelectric Materials	222
	Piezoelectric Composites	223
	Properties of 0-3 composites	224
	Aligning piezo particles in the polymer matrix	226
	Functional Properties of Aligned PZ1-Polymer Composites	228
	Using functional composites for energy harvesting	230
	Conclusions	230
	Acknowledgments	233
	References	234
CHAPTER 17	Biomimetic Materials JulianF.V. Vincent	235
	Molecular Structure	236
	Manipulating Liquid Crystals	238
	Hierarchy	240
	Assembly and Manufacture	241
	Biomimetic Materials	243
	Design criteria	244
	Conclusions	245
	References	245
CHAPTER 18	Lightweight Materials, Lightweight Design? Erik Tempelman	247
	Seven Rules for Lightweight Design	249
	Rule #1: do not overspecify	249
	Rule #2: do not use factors of ignorance	250

	Rule #3: avoid bending and torsion	251
	Rule #4: do not select materials independent of shape and manufacturing	
	methods	253
	Rule #5: do not use more joints than strictly necessary	255
	Rule #6: do not stop optimizing until the product cannot possibly be made	
	any lighter	256
	Rule #7: do not rule out steel—not yet!	256
	Conclusions	258
	Epilogue—the eighth rule	258
	References	258
Interview with	Sam Hecht	259
Interview with	Alberto Meda	267
Section 4	Proficiency in Materials	
CHAPTER 19	Materials Driven Design	277
	Aart van Bezooyen	
	Materials in the Design Process	278
	Relationship between Materials and Designers	279
	Materials Exploration versus Selection	281
	Materials Driven Design	282
	Three Case Studies	283
	More creative (Public)	283
	More sustainable (Design)	284
	More competitive (Business)	285
	Conclusions	286
	References	286
CHAPTER 20	Interaction between Functional and Human-Centered Attributes	
	in Materials Selection	287
	Kevin Edwards	
	The Materials Selection Process	289
	Materials selection in technical design	289
	Materials selection in industrial design	290
	Materials selection in product design	290
	The Influence of Design Thinking	290
	Applying selection methods	290
	Supporting decision making	291
	Materials information requirements	292
	Manipulating Material Attributes to Satisfy Design Requirements	292

	Interaction effects in materials	294
	Materials used in combination	296
	Materials substitution	296
	Total product implications	297
	Conclusions	297
	Acknowledgments	298
	References	298
CHAPTER 21	Modeling Materials Technology and the Designers' Perceptual Span <i>Eddie Norman</i>	301
	Mathematical Models of Materials Technology	303
	Visual Models of Materials Technology	307
	Technology for Design	309
	Materials technology for design	310
	Conclusions	312
	Acknowledgments	312
	References	312
CHAPTER 22	From Stiffness of Iron—Carbon Diagrams to Weakness of Sensoriality: The Manifold Designerly Ways of Developing Engineering	
	Competencies in Materials	315
	Luigi De Nardo and Maiinella Levi	
	Educational Programs from the Traditional Lecture Classroom to the	
	Informed Use of Materials and Technologies in Design	318
	Introductory classes at bachelor level of industrial design	320
	Technologies, elective courses, and support in studios at bachelor during	
	industrial design bachelor	322
	Master competence	324
	Combining mind-sets: design engineering	325
	The Inverse Perspective: "Design Driven" Materials Research	326
	Conclusions	327
	References	327
CHAPTER 23	The Concept-Context Approach to Learning Material Properties	
	in Design (-Related) Education <i>Maic J. de Vries</i>	329
	Current Educational Theories about Teaching and Learning Concepts	330
	Preconcepts Related to Materials	332
	Creating Cognitive Conflicts	334

INSPIRATIONA	AL RESOURCES FOR MATERIALS AND DESIGN	367
Interview with Can Yalman Interview with Dick Powell		359
		351
	References	348
	Conclusions	347
	Discussion	346
	Valentina Rognoli: expressive-sensorial atlas	345
	Hengfeng Zuo: material-aesthetics database	344
	Elvin Karana: meanings of materials tool	343
	Ilse Van Kesteren: material perception tools	342
	Four Prototypical Approaches	342
	New materials selection tools	341
	Contextual considerations	341
	Samples and product exemplars	341
	Sensorial-expressive language of materials	340
	Materials as a user interface	340
	User-Centered Materials Selection	338
	Owain Pedgley	
	New Tools	337
CHAPTER 24	Materials Selection for Product Experience: New Thinking,	
	References	336
	Conclusion	335
	A Concept-Context Approach For Learning Material Selection	335