

Contents

Contributors	xi
Preface	xvii
Biography.....	xix

SECTION 1 MICRO-PATTERNING IN 2D

CHAPTER 1	"Stamp-off" to Micropattern Sparse, Multicomponent Features	3
	Ravi A. Desai, Natalia M. Rodriguez, Christopher S. Chen	
	Introduction.....	4
1.1	Method.....	5
1.2	Discussion	11
	Acknowledgments	13
	References.....	13
CHAPTER 2	Poly(Vinyl Alcohol)-Micropatterned Surfaces for Manipulation of Mesenchymal Stem Cell Functions	17
	Guoping Chen	
	Introduction.....	18
2.1	Preparation of PVA-Micropatterned Surfaces.....	18
2.2	Effect of Cell Density and Cell-Cell Interaction on Adipogenic, Chondrogenic, and Osteogenic Differentiation of MSCs.....	21
2.3	Effect of Cell Spreading on Adipogenic and Osteogenic Differentiation of MSCs	25
2.4	Effect of Cell Geometry on Adipogenic Differentiation of MSCs	26
2.5	Effect of Cell Protrusion on Adipogenic Differentiation of MSCs	28
2.6	Effect of Surface Charge on Adipogenic Differentiation of MSCs	30
	Summary	31
	Acknowledgments	31
	References.....	31
CHAPTER 3	Patterning of Polymeric Cell Culture Substrates	35
	Alexander Welle, Simone Weigel, Özgül Demir Bulut	
	Introduction.....	36

	Patterning of Self-Assembled Monolayers	37
	Polymer Patterning	38
3.1	Equipment and Protocols	39
3.2	Results and Discussion	44
	Conclusions	51
	Acknowledgments	51
	References	52
CHAPTER 4	Photopatterning with a Printed Transparency Mask and a Protein-Friendly Photoresist	55
	Jiwoo Kang, Jong-Cheol Choi, Miju Kim, Hong-Ryul Jung, Junsang Doh	
	Introduction	56
4.1	Synthesis and Characterization of a Protein-Friendly Photoresist PDMP	57
4.2	Microscope Projection Photolithography	61
4.3	Micropatterning of Multiple Lymphocytes	65
4.4	Dynamic Micropatterning of Adhering Cells	68
	Summary and Outlook	71
	Acknowledgments	71
	References	71
CHAPTER 5	Plasma Microcontact Patterning (PμCP): A Technique for the Precise Control of Surface Patterning at Small-Scale	73
	Remigio Picone, Buzz Baum, Rachel McKendry	
	Introduction	74
5.1	Methods	76
5.2	Cell Patterning	82
5.3	Results	83
5.4	Discussion	86
	Acknowledgments	89
	References	89
CHAPTER 6	Patterning Gradients	91
	Nagaiyanallur V. Venkataraman, Clément V. M. Cremmel, Christian Zink, Rebecca P. Huber, Nicholas D. Spencer	
	Introduction	92
6.1	Surface-Chemical Gradients	92
6.2	Morphological Gradients	107
	References	120

SECTION 2 MASKLESS MICROPATTERNING

CHAPTER 7 Laser-Assisted Adsorption by Photobleaching..... 125

Jonathan M. Bélisle, Javier Mazzaferri, Santiago Costantino

Introduction..... 126

7.1 LAPAP Setup: Laser Scanning Version..... 127

7.2 Examples of Protein Patterns Produced with LAPAP 133

7.3 Multiple Protein Patterns 134

7.4 Widefield Illumination LAPAP 136

7.5 Quick and Easy LAPAP 138

Discussion and Conclusion..... 138

Acknowledgments 139

References..... 140

CHAPTER 8 Micropatterning with a Liquid Crystal Display (LCD) Projector 141

Kazuyoshi Itoga, Jun Kobayashi, Masayuki Yamato,

Teruo Okano

Introduction..... 142

8.1 Development of the Maskless Photolithography Devices
with an LCD Projector..... 143

8.2 Development of a Multistep Exposure System 147

8.3 Micropatterned Substrate Fabrication for Cell
Micropatterning 151

8.4 PDMS Microfluidic Channel Fabrication..... 155

8.5 Discussion 156

Summary 156

Acknowledgments 157

References..... 157

CHAPTER 9 Cell Patterning by Laser-Assisted Bioprinting 159

Raphaël Devillard, Emeline Pagès, Manuela Medina Correa,

Virginie Kériquel, Murielle Rémy, Jérôme Kalisky,

Muhammad Ali, Bertrand Guillotin, Fabien Guillemot

Introduction and Rationale 160

9.1 Materials..... 165

9.2 Methods 166

Conclusion 171

Acknowledgments 171

References..... 171

CHAPTER 10	Stereomask Lithography for Multi-Protein Patterning	175
	Siwei Zhao, Arnold Chen, Alexander Revzin, Tingrui Pan	
	Introduction and Rationale	176
10.1	Materials	178
10.2	Methods	179
10.3	Results and Discussion	184
	Conclusions	189
	Acknowledgments	189
	References	189
CHAPTER 11	Fabrication of Multifaceted, Micropatterned Surfaces and Image-Guided Patterning Using Laser Scanning Lithography	193
	John H. Slater, Jennifer L. West	
	Introduction	194
11.1	Substrate Preparation: Piranha Cleaning, Metal Deposition, and Alkanethiol Functionalization	197
11.2	Generation of Virtual Masks	201
11.3	Surface Patterning with LSL: General Method and Fabrication of Multifaceted Surfaces	204
11.4	Cell Deposition	212
11.5	Discussion	214
	General Conclusions	215
	References	216
CHAPTER 12	Print-to-Print: Printer-Enabled Out-of-Cleanroom Multiobject Microprinting Method	219
	Siyuan Xing, Siwei Zhao, Tingrui Pan	
	Introduction and Rationale	220
12.1	Materials	222
12.2	Methods	222
12.3	Discussion	226
	Acknowledgments	231
	References	232
SECTION 3	2D NANOPATTERNING	
CHAPTER 13	Soft/Elastic Nanopatterned Bointerfaces in the Service of Cell Biology	237
	Ilia Platzman, Katarzyna M. Gadomska, Jan-Willi Janiesch, Ilia Louban, E. Ada Cavalcanti-Adam, Joachim P. Spatz	
	Introduction	238

13.1	Nanopatterned Biomechanical Chip Fabrication: General Properties.....	239
13.2	Nanopatterned Hydrogel Scaffold: General Properties.....	247
13.3	Nanostructured Droplets of Water-in-Oil Emulsion: General Properties..... Summary and Outlook for the Future..... Acknowledgments..... References.....	251 258 258 258
CHAPTER 14 Combinatorial Screening of Mesenchymal Stem Cell Adhesion and Differentiation Using Polymer Pen Lithography.....261		
	Maria D. Cabezas, Daniel J. Eichelsdoerfer, Keith A. Brown, Milan Mrksich, Chad A. Mirkin	
	Introduction.....	262
14.1	Materials and Instrumentation.....	264
14.2	Methods.....	266
14.3	Discussion.....	272
	Summary.....	274
	Acknowledgments.....	275
	References.....	275
CHAPTER 15 High Fidelity Nanopatterning of Proteins onto Well-Defined Surfaces Through Subtractive Contact Printing.....277		
	José R. García, Ankur Singh, Andrés J. García	
	Introduction.....	278
15.1	Materials.....	280
15.2	Methods.....	281
15.3	Discussion.....	287
	Summary.....	290
	Acknowledgment.....	290
	References.....	290
CHAPTER 16 The Use of Microarrays and Fluorescence <i>In Situ</i> Hybridization for the Study of Mechanotransduction from Topography.....293		
	Laura E. McNamara, Matthew J. Dalby, Monica P. Tsimbouri	
	Introduction and Rationale.....	294
16.1	Materials/Equipment.....	297
16.2	Methods.....	298
16.3	Discussion.....	306

Summary.....	307
Acknowledgments.....	308
References.....	308
Index.....	311