



## Molecular layer deposition and protein interface patterning for guided cell growth

Manuel Glass

Schlüsseltechnologien / Key Technologies

Band / Volume 215

ISBN 978-3-95806-463-8

Forschungszentrum Jülich GmbH  
Institute of Complex Systems  
Bioelectronics (ICS-8)

# **Molecular layer deposition and protein interface patterning for guided cell growth**

Manuel Glass

Schriften des Forschungszentrums Jülich  
Reihe Schlüsseltechnologien / Key Technologies

Band / Volume 215

---

ISSN 1866-1807

ISBN 978-3-95806-463-8

# Contents

Abstract .....	i
Index of Abbreviations .....	ii
Contents .....	iii
1 Introduction .....	1
2 Theoretical Background .....	4
2.1 Self-Assembled Monolayer (SAM) .....	4
2.2 Binding Interaction .....	5
2.3 GLYMO and PLL .....	6
2.4 Temperature related Issues .....	7
3 Experimental Methods .....	9
3.1 Chemical Cleaning of Samples .....	9
3.2 Gas-phase Deposition (MLD) Setup GLOBUS .....	9
3.2.1 Activation and Silanization .....	11
3.2.2 Complete Deposition Procedure .....	13
3.3 Optical Heater & Temperature Sensor for the MLD .....	14
3.3.1 Overview of the Extensions .....	14
3.3.2 E-beam Lithography .....	16
3.3.3 Temperature Sensor .....	21
3.3.4 Temperature Calibration .....	22
3.4 Ex-situ Analysis .....	24
3.4.1 Referenced Spectroscopic Ellipsometry (RSE) .....	24
3.4.2 Surface Potential Measurements .....	29
3.4.3 Fluorescence Microscopy .....	32
3.5 Patterned Neuronal Culture .....	34
3.5.1 Patterning of Molecular Layers with Lithography and Lift-off Technique .....	34
3.5.2 Neuronal Cell Culture .....	35
3.5.3 Neuron Density Analysis .....	36
4 Gas-Phase Deposition of GLYMO at Elevated Temperatures .....	37
4.1 Referenced Spectroscopic Ellipsometer (RSE) .....	37
4.2 Fluorescence Microscopy .....	40
4.3 Surface Potential Measurements .....	43

4.4	Conclusion .....	47
5	Interface Patterning with GLYMO and PLL .....	48
5.1	PLL on chemically bound GLYMO SAMs .....	48
5.1.1	Thickness of PLL on GLYMO .....	48
5.1.2	$\zeta$ Potential of PLL .....	49
5.2	Patterning Process .....	51
5.2.1	Structure Check after PMMA Development .....	52
5.2.2	Structure Check after Lift-off .....	54
5.3	Conclusion .....	58
6	Guided Neuron Growth .....	60
6.1	Neuron Density .....	60
6.2	Guided Growth in Various Structures .....	62
	Guided Growth in Bar Structures .....	62
	Guided Growth in Square Structures .....	63
	Guided Growth in circle and triangle Structures .....	66
6.3	Structural Defects .....	69
	The “epoxy adhesive” effect .....	69
	The “small coffee ring” effect .....	70
	The “big coffee ring” effect .....	70
6.4	Conclusion .....	72
7	Summary .....	73
	MLD .....	73
	Patterning Method .....	74
	Guided Neuron Growth .....	74
	A small Outlook .....	75
8	References .....	77
	Acknowledgements .....	81

Schlüsseltechnologien / Key Technologies

Band / Volume 215

ISBN 978-3-95806-463-8