

Contents

1	Introduction	1
	References	4
Part I Scientific and Technical Background		
2	Dissociated Neuronal Networks Coupled to Micro-Electrode Arrays Devices.	9
2.1	Neurons and Synapses	9
2.2	In Vitro Preparations	12
2.2.1	Slice Preparations	12
2.2.2	Cultured Neuronal Networks.	13
2.3	Electrophysiology Techniques	15
2.4	MEA for Network Electrophysiology	17
2.5	MEA Technology	18
2.5.1	Standard MEA	19
2.5.2	Experimental Set-up.	21
2.6	Increasing Spatial Resolution with MEAs	23
2.7	MEA Applications	24
2.7.1	Neuro-Pharmacological Applications	25
2.7.2	Plasticity Studies	26
	References	27
3	In Vitro Neuronal Networks.	31
3.1	Homogeneous Neuronal Networks	31
3.1.1	Spontaneous Activity	32
3.2	Patterned Neuronal Networks	34
3.3	Beyond the State of the Art: 3D Neuronal Networks	37
	References	40

Part II A New In Vitro Model: 3D Neural Networks Coupled to MEA Devices

4	3D Neuronal Networks: State of the Art	45
4.1	2D Versus 3D Models	45
4.2	Engineered 3D Neuronal Networks	47
4.2.1	Bioactive Extracellular Matrix-Based Scaffold	48
4.2.2	Micro-Beads Based Scaffold	51
4.2.3	Hydrogels Versus Beads Scaffolds	54
	References	55
5	3D Neuronal Networks Coupled to MEAs	59
5.1	3D Neuronal Networks Coupled to MEA Devices	59
5.2	Imaging Characterization	63
5.3	3D Hippocampal Neuronal Network Dynamics	69
5.3.1	Spontaneous Activity	69
5.3.2	Stimulus-Evoked Activity	91
5.3.3	Chemical Modulation	100
5.4	3D Cortical Neuronal Network Dynamic	106
	References	112

Part III Additional Applications with MEA Technology

6	Neuro-Pharmacological Studies	117
6.1	Effect of Ionotropic Glutamate's Agonists	117
6.1.1	Effect of AMPA	118
6.1.2	Effect of NMDA	121
6.1.3	Effect of Exogenous Glutamate	123
6.2	Effect of Antiepileptic Drugs	123
6.2.1	Effect of CBZ	125
6.2.2	Effect of VPA	126
	References	130

Part IV Discussion and Conclusion

7	Conclusion of the Thesis and Future Perspectives	135
7.1	Imaging Characterization	135
7.2	Spontaneous Activity	136
7.3	Stimulus-Evoked Activity	137
7.4	Chemical Modulation	138
7.5	Comparison with Other Studies	139
7.6	Applications and Further Perspectives	139
	References	140

Appendix: Data Analysis	143
--------------------------------	-----

<http://www.springer.com/978-3-319-30236-2>

Neuronal Network Dynamics in 2D and 3D in vitro
Neuroengineered Systems

Frega, M.

2016, XIII, 148 p. 97 illus., 43 illus. in color., Hardcover

ISBN: 978-3-319-30236-2