

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/56250> holds various files of this Leiden University dissertation

Author: Wel, Casper van der

Title: Lipid mediated colloidal interactions

Date: 2017-10-05

Lipid mediated colloidal interactions

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof. mr. C.J.J.M. Stolkers,
volgens besluit van het College voor Promoties
te verdedigen op donderdag 5 oktober 2017
klokke 16:15 uur

door

Casper Michiel van der Wel
geboren te Hilversum in 1988

Promotor: Prof. dr. T. Schmidt
Co-promotores: Dr. D.J. Kraft
Dr. D. Heinrich

Promotiecommissie: Dr. T. Idema (*Technische Universiteit Delft*)
Prof. dr. W.K. Kegel (*Universiteit Utrecht*)
Prof. dr. A.M. Dogterom
Prof. dr. E.R. Eliel
Prof. dr. M.A.G.J. Orrit
Dr. S. Semrau

Casimir PhD series, Delft-Leiden, 2017-27
ISBN 978-90-8593-311-3

 This thesis is licensed under the open source CC-BY-SA 4.0 license, excluding Figures 1.2, 1.3, and 1.5, and Chapters 2, 4, 6, and 7. An electronic version of this thesis can be found at openaccess.leidenuniv.nl. Supporting videos are accessible at goo.gl/KqUeIa or via QR codes printed in the margin.

The work described in this thesis was supported by the Netherlands Organisation for Scientific Research (NWO/OCW), as part of the Frontiers of Nanoscience (NanoFront) program.

The cover shows a time sequence of two particles (in green) wrapped by a vesicle (in magenta). The overlap of green and magenta gives a white colour, which confirms that the particles are wrapped by the membrane. The magnification is 618 times: if this thesis were 0.3 mm wide, the images would be approximately at the correct scale. The time difference between two images is 0.2 s horizontally and 14.4 s vertically.

Contents

1	Introduction	1
1.1	Lipid membranes: a biological view	2
1.2	Lipid membranes: a physical view	4
1.3	Lipids in self-assembly	6
I	Methods of single particle tracking	9
2	Tracking of colloidal clusters with sub-pixel accuracy and precision	11
2.1	Introduction	12
2.2	Methods	13
2.3	Results and Discussion	19
2.4	Conclusion	27
2.5	Supporting Figures	31
3	Force measurement from sparse trajectories in curved geometries	31
3.1	Introduction	32
3.2	Methods	32
3.3	Position-based force measurement	33
3.4	Displacement-based force measurement	36
3.5	Estimating forces in curved geometries	41
3.6	Summary and Conclusion	44
3.7	Appendices	46
II	Membrane mediated interactions	49
4	Surfactant-free colloidal particles with specific binding affinity	51
4.1	Introduction	52
4.2	Methods	53
4.3	Results and Discussion	58
4.4	Conclusion	66

5 Membrane-mediated attraction between curvature inducing objects	67
5.1 Introduction	68
5.2 Methods	69
5.3 Results and Discussion	73
5.4 Conclusion	80
6 Microparticle assembly pathways on lipid membranes	83
6.1 Introduction	84
6.2 Methods	84
6.3 Results and Discussion	88
6.4 Conclusion	97
III Lipids for colloidal self-assembly	99
7 Colloidal organosilica spheres through spontaneous emulsification	101
7.1 Introduction	102
7.2 Methods	105
7.3 Results and Discussion	108
7.4 Conclusion	115
7.5 Supporting Figures	116
8 Lipid monolayers supported by TPM microemulsions	123
8.1 Introduction	124
8.2 Methods	124
8.3 Results and Discussion	128
8.4 Conclusion	134
Samenvatting	135
Publication List	137
Curriculum Vitae	139
Acknowledgement	141
Bibliography	143