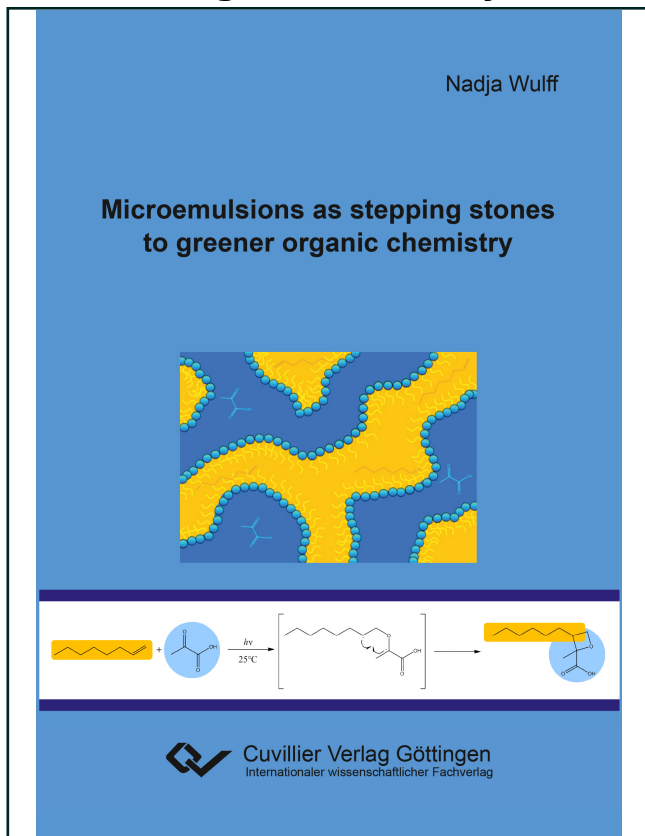




Nadja Wulff (Autor)

Microemulsions as stepping stones to greener organic chemistry



<https://cuvillier.de/de/shop/publications/6887>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen,
Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>



Index

| | | |
|----------|--|----------|
| 1 | Introduction..... | 1 |
| 1.1 | Task description | 5 |
| 2 | Fundamentals..... | 7 |
| 2.1 | Microemulsions | 7 |
| 2.1.1 | Phase behavior | 7 |
| 2.1.1.1 | Binary side systems | 8 |
| 2.1.1.2 | Ternary systems..... | 9 |
| 2.1.1.3 | $T(\gamma)$ -section | 10 |
| 2.1.1.4 | Additives..... | 12 |
| 2.1.2 | Microstructure | 14 |
| 2.1.2.1 | Microstructure within the $T(\gamma)$ -section | 14 |
| 2.1.2.2 | Amphiphilic film | 16 |
| 2.1.2.3 | Interfacial tension and domain size | 18 |
| 2.2 | Surfactants | 20 |
| 2.2.1 | Non-ionic surfactants | 21 |
| 2.2.1.1 | Polyethylene glycol alkyl ether (C_iE_j) | 21 |
| 2.2.1.2 | Alkyl glycosides (C_mG_n)..... | 23 |
| 2.2.2 | Biosurfactants | 24 |
| 2.2.2.1 | Sophorolipids..... | 25 |
| 2.2.2.2 | Mannosylerythritolipids..... | 26 |
| 2.2.2.3 | Cellobioselipids | 27 |
| 2.3 | Theoretical basics | 28 |
| 2.3.1 | Small angle neutron scattering | 28 |
| 2.3.1.1 | Model of bicontinuous phases | 29 |
| 2.3.2 | Rheology | 31 |
| 2.3.3 | Surface tension measurements | 35 |
| 2.3.4 | Sound and ultrasound | 38 |
| 2.4 | Photochemistry | 40 |
| 2.4.1 | <i>Paternò-Büchi</i> reaction | 40 |



| | | |
|----------|--|-----------|
| 2.4.1.1 | General mechanism | 41 |
| 3 | Experimental section | 45 |
| 3.1 | Phase behavior | 45 |
| 3.2 | UV irradiation of microemulsions | 46 |
| 3.3 | Ultrasound | 47 |
| 3.4 | Electric Conductivity | 48 |
| 3.5 | Small angle neutron scattering | 49 |
| 3.5.1 | Experimental setup | 49 |
| 3.5.2 | Raw data treatment | 50 |
| 3.6 | Freeze fracture electron microscopy | 51 |
| 3.7 | Rheology | 52 |
| 3.8 | Surface tension | 53 |
| 4 | Results and Discussion..... | 55 |
| 4.1 | <i>Paternò-Büchi</i> reaction in a microemulsion | 55 |
| 4.1.1 | Phase behavior | 57 |
| 4.1.1.1 | The effect of 1-octene | 57 |
| 4.1.1.2 | The effect of pyruvic acid..... | 58 |
| 4.1.1.3 | Formulating the basic microemulsion system | 60 |
| 4.1.1.4 | UV irradiation at low surfactant mass fraction..... | 62 |
| 4.1.1.5 | UV irradiation at high surfactant mass fraction..... | 65 |
| 4.1.1.6 | Influence of the molar equivalence..... | 66 |
| 4.1.1.7 | UV irradiation without 1-octene..... | 67 |
| 4.1.1.8 | The effect of caprylic acid | 69 |
| 4.1.2 | Microstructure | 71 |
| 4.1.2.1 | Small angle neutron scattering..... | 71 |
| 4.1.2.2 | Freeze fracture electron microscopy..... | 73 |
| 4.1.2.3 | Conductivity measurements..... | 75 |
| 4.1.3 | Analysis of the reaction | 77 |
| 4.1.3.1 | Monitoring the pH during the reaction | 77 |
| 4.1.3.2 | Monitoring the electric conductivity during the reaction | 79 |



| | | |
|----------|---|------------|
| 4.1.4 | Ultrasound | 81 |
| 4.1.4.1 | Pulsed ultrasound versus continuous ultrasound | 81 |
| 4.1.4.2 | Variation of the amplitude | 83 |
| 4.1.4.3 | Variation of the sonotrode thickness | 86 |
| 4.2 | Biosurfactants | 88 |
| 4.2.1 | Phase behavior | 89 |
| 4.2.1.1 | The effect of alkyl glycosides | 89 |
| 4.2.1.2 | Characterization of cellobioselipids | 92 |
| 4.2.1.1 | Characterization of mannosylerythritollipids | 97 |
| 4.2.2 | Rheology | 106 |
| 4.2.2.1 | Rheological properties of comparative substances | 106 |
| 4.2.2.2 | Rheological properties of mannosylerythritollipids | 108 |
| 4.2.3 | Surface tension | 111 |
| 4.3 | Bio-based microemulsion as green reaction media | 120 |
| 4.3.1 | Formulating microemulsions on a biologic basis | 120 |
| 4.3.1.1 | Combination of the surfactants C ₁₀ E ₄ , MEL (97), and C ₈ G ₁ | 121 |
| 4.3.1.2 | Combination of the surfactants C ₁₀ E ₄ , MEL (80), and C ₈ G ₁ | 123 |
| 4.3.2 | <i>Paternò-Büchi</i> reaction in a green microemulsion | 124 |
| 5 | Conclusion | 129 |
| 6 | Appendix | 133 |
| A 1 | Materials | 133 |
| A 2 | \tilde{X} -points and efficiency | 134 |
| A 2.1 | The effect of 1-octene and pyruvic acid | 134 |
| A 2.2 | The effect of UV irradiation | 134 |
| A 2.3 | The effect of biosurfactants | 135 |
| A 3 | Rheology | 136 |
| A 3.1 | Viscosity curves of mannosylerythritollipids | 136 |
| A 3.2 | Flow curves of mannosylerythritollipids | 137 |
| A 4 | List of abbreviations | 138 |
| 7 | Literature | 143 |