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Towards artificial photosynthesis on the lipid bilayer of liposomes

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List of Publications

“Performance of a non-local van der Waals density functional on the dissociation of H₂ on metal surfaces”

Mark Wijzenbroek, David M. Klein, Bauke Smits, Mark F. Somers, and Geert-Jan Kroes, *The Journal of Physical Chemistry A*, **2015**, *119*, 12146-12158.

“Roadmap towards solar fuel synthesis at the water interface of liposome membranes”

Andrea Pannwitz*, David M. Klein*, Santiago Rodríguez-Jiménez, Carla Casadevall, Hongwei Song, Erwin Reisner, Leif Hammarström, and Sylvestre Bonnet, *Chemical Society Reviews*, **2021**, *50*, 4833-4855.

* These authors contributed equally to this work.

“Degradation of lipid-based drug delivery formulations during nebulization”

David M. Klein, Albert Poortinga, Frank M. Verhoeven, Daniel Bonn, Sylvestre Bonnet, and Cees J. M. van Rijn, *Chemical Physics*, **2021**, *547*, 111192.

“Shorter Alkyl Chains Enhance Molecular Diffusion and Electron Transfer Kinetics Between Photosensitisers and Catalysts in CO₂-Reducing Photocatalytic Liposomes”

David M. Klein, Santiago Rodríguez-Jiménez, Marlene E. Hoefnagel, Andrea Pannwitz, Amrutha Prabhakaran, Maxime A. Siegler, Tia E. Keyes, Erwin Reisner, Albert M. Brouwer, and Sylvestre Bonnet, *Chemistry – A European Journal*, **2021**, *27* (68), 17203-17212.

“A stable alkylated cobalt catalyst for photocatalytic H₂ generation in liposomes”

David M. Klein, Leonardo Passerini, Martina Huber and Sylvestre Bonnet, *ChemCatChem*, **2022**, *accepted*.

“Interfacial characterization of ruthenium-based amphiphilic photosensitizers”

Yousra Timounay, Andrea Pannwitz, David M. Klein, Anne-Laure Biance, Marlene E. Hoefnagel, Indraneel Sen, Alain Cagna, Marie le Merrer, and Sylvestre Bonnet, *Langmuir*, **2022**, *accepted*.

“A lock-and-kill anticancer photoactivated chemotherapy agent”

Erik P. van Geest, Sina K. Götzfried, David M. Klein, Vadde Ramu, Nadiya Salitra, Sorraya Popal, Corjan van der Griend, Xuequan Zhou, Gregory F. Schneider, and Sylvestre Bonnet, *manuscript submitted*.

“Unidirectional transmembrane photoinduced electron transfer with membrane-embedded metallopeptides”

David M. Klein, Xinmeng Li, Aimee L. Boyle, Rianne van der Pol, G. J. Agur Sevink, Albert M. Brouwer, and Sylvestre Bonnet, *manuscript in preparation*.

Curriculum Vitae

The author of this thesis, David Maarten Klein, was born in Haarlem, the Netherlands, on December 20th, 1993. In 2011 he graduated from the Stedelijk Gymnasium Haarlem. From 2012 to 2015, he performed his BSc studies Molecular Science and Technology at Leiden University and Delft University, with a final thesis entitled “The crystal structure of solid N₂O: insights from first-principles calculations” under the supervision of dr. J. Meyer at Leiden University. From 2015 to 2017, he followed the Chemistry MSc program at Leiden University, with the specialisation Energy & Sustainability, and in parallel he followed the class of excellence “Sustainability: the Molecular Approach” from the Holland Research School of Molecular Chemistry (HRSMC), a collaboration between Leiden University, the University of Amsterdam (UvA), and the Free University of Amsterdam. During his MSc studies, he won the “VNCI Topsector Chemiebeurs” prize (2015) and as a result he performed an internship at LyondellBasell (Rotterdam Botlek). He graduated cum laude in 2017, with a thesis entitled “Developing stable photosensitizers for photocatalytic water oxidation” under the supervision of Prof. dr. S. Bonnet.

His PhD research proposal “Unidirectional electron transfer across lipid bilayers for artificial water splitting using transmembrane peptide-photosensitizer conjugates and liposomes” was granted by the HRSMC. He started hence his PhD studies at Leiden University under the co-supervision of Prof. dr. S. Bonnet and Prof. dr. A. M. Brouwer (UvA). During his PhD studies, he collaborated with dr. S. Rodríguez-Jiménez, dr. C. Casadevall, and Prof. dr. E. Reisner from the University of Cambridge, dr. H. Song and Prof. dr. L. Hammarström from Uppsala University, A. Prabhakaran and Prof. dr. T. Keyes from Dublin University, dr. A. Pannwitz from Ulm University, dr. A. Boyle, dr. A. Sevink, and dr. X. Li from Leiden University, dr. M. Siegler from Johns Hopkins University, and dr. A. Poortinga, Prof. dr. D. Bonn and Prof. dr. C. van Rijn from UvA. He supervised four MSc students and worked as a teaching assistant for the bachelor courses “Practicum Basisvaardigheden”, “Practicum Organische Chemie”, “Inorganische Chemie”, and “Leren

Onderzoeken". Furthermore, he took several post-graduate courses including the HRSMC courses "High Impact Writing" and the Leiden University Courses "Scientific Conduct in Science", "Effective communication in Science", "Communication in Science", "Job Orientation", and "Job Search Skills". He took part within the organisation committee of the HRSMC Sustainability Workshop (2019) and he was also member of the HRSMC PhD platform from 2019 – 2021.

Parts of the results reported in this thesis were presented at several (inter)national conferences as listed below:

- International Conference on Photochemistry, virtual conference, July 2021 (oral, runner-up for best oral presentation award)
- NWO CHemistry As INnovating Science (CHAINS), virtual conference, December 2021 (poster)
- Symposium of the Holland Research School of Molecular Chemistry, Amsterdam, The Netherlands, November 2019 (poster) and March 2022 (poster)
- Netherlands' Catalysis and Chemistry Conference, Noordwijkerhout, The Netherlands, March 2018 (poster) and March 2019 (poster)
- Autumn School: Advanced Metal-Organic Chemistry and Catalysis, Doorn, The Netherlands, September-October 2018 (poster)

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I also would like to thank Andrea and Ramu for their technical assistance with confocal microscopy measurements, Dr. Sipeng Zheng, Hans van der Elst, Nico Meeuwenoord, dr. Bobby Florea, and Laura Opdam for MS measurements and ICP measurements, Maximilian Paradiz Dominquez and Michiel Hilbers for their technical assistance with time-resolved absorption spectroscopy measurements at the University of Amsterdam and for their assistance with Glotaran.

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Last but not least, I would like to thank my wife Chawa for supporting me during this PhD journey, first as girlfriend, then as fiancée and finally as wife. I would like to thank our sons Yoav and Elon for letting me become more productive at work in the final years of my PhD as well as for providing me the possibility to work in the middle of the night.