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Core cross-linked polymeric micelles based on polypept(o)ides: from secondary structure formation of polypeptides to functional cross-linking strategies for polymeric micelles

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Citation

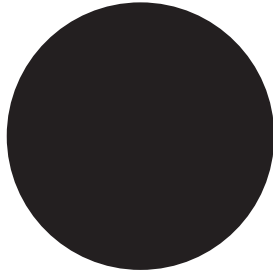
Bauer, T. A. (2022, June 9). *Core cross-linked polymeric micelles based on polypept(o)ides: from secondary structure formation of polypeptides to functional cross-linking strategies for polymeric micelles*. Retrieved from <https://hdl.handle.net/1887/3307845>

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Curriculum Vitae
Scientific Publications
Ph.D. Portfolio

Curriculum Vitae

Tobias Alexander Bauer was born on May 10th, 1989, in Mainz, Germany. In 2008, he obtained his high school degree from the Bischöfliches Willigis-Gymnasium in Mainz, Germany. In the same year, he started a vocational training as a chemical laboratory technician at Sanofi-Aventis Deutschland GmbH in Frankfurt a. M., Germany, and graduated in 2011. After six months of working as a technician, he started studying chemistry at Johannes Gutenberg University (JGU) in Mainz, Germany. In 2015, he obtained the degree Bachelor of Science in chemistry, followed by the degree Master of Science in chemistry in 2017. For his bachelor's thesis, he focused on the synthesis of polythiophenes for applications in hybrid solar cells under the supervision of Prof. Dr. R. Zentel. During his master's studies, he joined the University of Toronto, Canada, for six months. Supported by Prof. Dr. M. Shoichet, he encountered the medical application of polymers for tissue engineering and drug delivery. Back at JGU, he started research for his master's thesis on polymeric micelles for drug delivery with Dr. M. Barz. His master's thesis was awarded by the Fritz-Henkel-Stiftung. After his studies, he returned to Sanofi-Aventis Deutschland GmbH for an internship opportunity in project management. In 2017, he started his Ph.D. research at the Department of Chemistry at the JGU in Mainz under the supervision of Dr. M. Barz in close collaboration with the collaborative research center CRC1066 for nanodimensional polymer therapeutics for tumor therapy. He successfully applied for funding from the HaVo Stiftung and the Graduate School of Excellence Materials Science in Mainz. In his Ph.D. research, he investigated polypept(o)ides as a novel material for drug delivery, focusing on the synthesis and application of core cross-linked polymeric micelles, as described in this thesis. Together with Prof. Dr. M. Barz, he transferred to Leiden Academic Centre for Drug Research at Leiden University, Leiden, the Netherlands, in 2020. Here, he was further supervised by Prof. Dr. A. Kros from the Leiden Institute of Chemistry. Until December 2021, he finalized his research projects leading to several publications. He presented his research at numerous summer schools and national and international conferences and received two presentation awards. During his Ph.D. research, he was involved in lecturing and teaching practical academic courses. Further, he trained and supervised a laboratory technician trainee and Bachelor and Master students. Since February 2022, he has been working as a project manager for polymer development at the department of Research, Development & Innovation at Evonik Operations GmbH in Darmstadt, Germany.

Scientific Publications / Manuscripts of This Thesis

Bauer, T. A.; Muhl, C.; Schollmeyer, D.; Barz, M. Racemic S-(Ethylsulfonyl)-DL-cysteine N-Carboxyanhydrides Improve Chain Lengths and Monomer Conversion for B-Sheet-Controlled Ring-Opening Polymerization. *Macromol. Rapid Commun.* **2021**, *42* (8), 2000470.

Bauer, T. A.; Imschweiler, J.; Muhl, C.; Weber, B.; Barz, M. Secondary Structure-Driven Self-Assembly of Thiol-Reactive Polypept(o)ides. *Biomacromolecules* **2021**, *22* (5), 2171–2180.

Bauer, T.A.; Alberg, I.; Zengerling, L.A.; Zhang, H.; Besenius, P.; Koynov, K.; Slütter, B.; Zentel, R.; Barz, M. Tuning the Cross-Linking Density of Polymeric Micelles and its Implications on Particle Stability in Human Blood Plasma. *to be submitted to Biomacromolecules*.

Bauer, T.A.; Schramm, J.; Fenaroli, F.; Siemer, S.; Seidl, C.I.; Morsbach, S.; Bleul, R.; Stauber, R.; Maskos, M.; Barz, M. Complex Structures Made Simple - Continuous Flow Production of Core Cross-Linked Polymeric Micelles for Paclitaxel Pro-Drug-Delivery. *to be submitted to Advanced Materials*.

Bauer, T. A.; Eckrich, J.; Wiesmann, N.; Kuczelinis, F.; Sun, W.; Zeng, X.; Weber, B.; Wu, S.; Bings, N. H.; Strieth, S.; Barz, M. Photocleavable Core Cross-Linked Polymeric Micelles of Polypept(o)ides and Ruthenium(II) Complexes. *J. Mater. Chem. B* **2021**, *9* (39), 8211–8223.

Siemer, S.; **Bauer, T.A.;** Scholz, P.; Breder, C.; Fenaroli, F.; Harms, G.; Dietrich, D.; Dietrich, J.; Rosenauer, C.; Barz, M.; Becker, S.; Strieth, S.; Reinhardt, C.; Fauth, T.; Hagemann, J.; Stauber, R.H. Targeting Cancer Chemotherapy Resistance by Precision Medicine Driven Nanoparticle-Formulated Cisplatin. *ACS Nano* **2021**, *15*, 18541–18556.

Bauer, T. A.*; Horvat, N. K.*; Marques, O.; Chocarro, S.; Mertens, C.; Colucci, S.; Schmitt, S.; Carrella, L. M.; Morsbach, S.; Koynov, K.; Fenaroli, F.; Blümmler, P.; Jung, M.; Sotillo, R.; Hentze, M. W.; Muckenthaler, M. U.; Barz, M. Core Cross-Linked Polymeric Micelles for Specific Iron Delivery: Inducing Sterile Inflammation in Macrophages. *Adv. Healthc. Mater.* **2021**, *10* (19), 2100385.

* both authors contributed equally

Other Scientific Publications

Dal, N.-J. K.; Kocere, A.; Wohlmann, J.; Van Herck, S.; **Bauer, T. A.**; Resseguier, J.; Bagherifam, S.; Hyldmo, H.; Barz, M.; De Geest, B. G.; Fenaroli, F. Zebrafish Embryos Allow Prediction of Nanoparticle Circulation Times in Mice and Facilitate Quantification of Nanoparticle–Cell Interactions. *Small* **2020**, *16*, 1906719.

Johann, K.; Svatunek, D.; Seidl, C.; Rizzelli, S.; **Bauer, T. A.**; Braun, L.; Koynov, K.; Mikula, H.; Barz, M. Tetrazine- and: Trans -Cyclooctene-Functionalised Polypept(o)ides for Fast Bioorthogonal Tetrazine Ligation. *Polym. Chem.* **2020**, *11*, 4396–4407.

Holm, R.; Douverne, M.; Weber, B.; **Bauer, T.**; Best, A.; Ahlers, P.; Koynov, K.; Besenius, P.; Barz, M. Impact of Branching on the Solution Behavior and Serum Stability of Starlike Block Copolymers. *Biomacromolecules* **2019**, *20*, 375–388.

Steinborn, B.; Hirschle, P.; Höhn, M.; **Bauer, T.**; Barz, M.; Wuttke, S.; Wagner, E.; Lächelt, U. Core-Shell Functionalized Zirconium-Pemetrexed Coordination Nanoparticles as Carriers with a High Drug Content. *Adv. Ther.* **2019**, *2*, 1900120.

Zimpel, A.; Al Danaf, N.; Steinborn, B.; Kuhn, J.; Höhn, M.; **Bauer, T.**; Hirschle, P.; Schrimpf, W.; Engelke, H.; Wagner, E.; Barz, M.; Lamb, D. C.; Lächelt, U.; Wuttke, S. Coordinative Binding of Polymers to Metal-Organic Framework Nanoparticles for Control of Interactions at the Biointerface. *ACS Nano* **2019**, *13*, 3884–3895.

Menk, F.*; Fokina, A.*; Oschmann, B.*; **Bauer, T. A.***; Nyquist, Y.; Braun, L.; Kiehl, J.; Zentel, R. Functionalization of P3HT with Various Mono- and Multidentate Anchor Groups. *J. Braz. Chem. Soc.* **2018**, *29*, 1076–1085.

* these authors contributed equally

Otter, R.; Henke, N. A.; Berac, C.; **Bauer, T.**; Barz, M.; Seiffert, S.; Besenius, P. Secondary Structure-Driven Hydrogelation Using Foldable Telechelic Polymer–Peptide Conjugates. *Macromol. Rapid Commun.* **2018**, *39*, 1800459.

Muhl, C.; Schäfer, O.; **Bauer, T.**; Räder, H.-J.; Barz, M. Poly(S-Ethylsulfonyl-L-Homocysteine): An α -Helical Polypeptide for Chemoselective Disulfide Formation. *Macromolecules* **2018**, *51*, 8188–8196.

Kemper, B.; Zengerling, L.; Spitzer, D.; Otter, R.; **Bauer, T.**; Besenius, P. Kinetically Controlled Stepwise Self-Assembly of Au^I-Metallopeptides in Water. *J. Am. Chem. Soc.* **2018**, *140*, 534–537.

Klinker, K.; Schäfer, O.; Huesmann, D.; **Bauer, T.**; Capelôa, L.; Braun, L.; Stergiou, N.; Schinnerer, M.; Dirisala, A.; Miyata, K.; Osada, K.; Cabral, H.; Kataoka, K.; Barz, M. Secondary-Structure-Driven Self-Assembly of Reactive Polypept(o)ides: Controlling Size, Shape, and Function of Core Cross-Linked Nanostructures. *Angew. Chemie Int. Ed.* **2017**, *56*, 9608–9613.

Patent Application

Bauer, T.A.; Barz, M.; Horvat, N.; Muckenthaler, M.U.; Hentze, M.W.;

Nanoparticles Comprising Iron Oxide Particles Embedded in Polymeric Micelles, Patent Application Nr. PCT/EP2021/083200; filed together with the European Molecular Biology Laboratory and the Heidelberg University.

Ph.D. Portfolio

Conference Attendancies

2021 LACDR Spring Symposium (online/Leiden, The Netherlands), oral presentation.

Controlled Release Society, BeNeLux Local Chapter Meeting (online/Aachen, Germany), oral flash-presentation.

2019 Debugging the NanoBio-Interfaces to Promote Clinical Translation (Mainz, Germany), oral presentation.

8th BioIron Symposium (Heidelberg, Germany).

2018 12th International Symposium on Polymer Therapeutics (Valencia, Spain), poster presentation.

256th Annual Meeting of the American Chemical Society (Boston, USA), oral presentations.

Gordon Research Conference: Drug Carriers in Medicine and Biology (Mt. Snow, USA), poster presentation.

12th CLINAM Summit (Basel, Switzerland).

2017 Annual Meeting SF Nano (France).

Summer Schools

2021 Leibniz Young Polymer Scientist Forum (online/Aachen, Germany)

2019 Nanomedicine - Formulation, Characterization, Translation (SFB 1066 and SFB1278, Fulda, Germany).

Student Seminar of the Graduate School of Excellence MAINZ (Strasbourg, France)

2018 Nanodimensionale polymere Therapeutika für die Tumorthherapie (SFB1066, Bad Münster am Stein, Germany).

Student Seminar of the Graduate School of Excellence MAINZ (Budapest, Hungary).

2017 Summer School macro2fun (Mainz, Germany).

Compulsory Courses

- 2021** Scientific Conduct
- 2020** Basic Certificate in Project Management (IPMA Guideline)
- 2019** Young Entrepreneurs in Science
- 2018** Business Studies for Chemists
- 2017** Presentation in English
- Industrial Process Engineering and Development