BIOGRAPHICAL SKETCH

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NAME: Trebbin, Martin Werner

eRA COMMONS USER NAME (credential, e.g., agency login): none yet

POSITION TITLE: Assistant Professor of Chemistry, Empire Innovation Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Hamburg, Germany	Dipl.-Chem.	07/2009	Chemistry
University of Bayreuth, Germany	Dr. rer. nat. (*summa cum laude*)	12/2013	Physical Chemistry
University of Bayreuth, Germany	Postdoctoral	09/2014	Physical Chemistry

A. Personal Statement

Dr. Martin Trebbin is Empire Innovation Assistant Professor at the Department of Chemistry and connected to the NSF science and technology center BioXFEL and RENEW. His research focuses on the time-resolved structure determination of ultrafast protein structural dynamics, soft matter self-assembly and the nucleation & growth of nanoparticles. This interdisciplinary research profile fits and aligns very with the mission and goals of BioXFEL, RENEW and their members.

Our world is dynamic and complex. This simple fact makes modern science so interesting, but also challenging. Many of today's driving scientific questions about energy, materials and biology might be unraveled if one could observe the motion of atoms and molecules in action. The recording of such a "molecular movie" would not only deepen our knowledge about the world, but also revolutionize medicine and allow us to create better materials for energy and technology applications. Driven by this goal, Trebbin's research interests and activities are focused on investigating structure-function relationships and dynamics of bio-macromolecules, polymers and nanoparticles. Specifically, the Trebbin lab harnesses modern structure determination techniques in combination with state-of-the-art microfluidics. The primarily used characterization methods are X-ray scattering and -diffraction at X-ray free-electron lasers and synchrotrons as well as cryo-electron microscopy. Using lithography and microfabrication techniques, the Trebbin lab creates tailored microfluidic devices that can handle smallest fluid volumes with great control and which are optimized for the mentioned structure determination techniques. This combination does not only enable high-resolution structure determination from scarcely available materials, but it also enables the collection of high throughput and time-resolved structural data of the sample systems. Trebbin's broad background and expertise in chemistry includes specific training in physical chemistry and structural biology which are key research areas for this research program.

Martin Trebbin has been working on microfluidics since early 2009, with a strong focus on structure determination methods using X-rays (small-/wide-angle X-ray scattering, SAXS/WAXS) and handling of smallest amounts of samples for which he received his doctoral degree in 2013 (summa cum laude) at the University of Bayreuth (Germany). In 2014 he started working at the excellence cluster "Centre for Ultrafast Imaging" at the University of Hamburg (Germany). During this independent group leader position as Assistant Professor dedicated to "Ultrafast structure determination in liquids", Trebbin has intensified this direction and expanded his expertise into time-resolved X-ray serial macromolecular crystallography (SFX, SSX) using X-ray free-electron lasers (XFELs) and synchrotrons (using both monochromatic and Laue radiation). In collaboration with Dr. Stephen Muench (Astbury Centre for Structural Molecular Biology, University of Leeds, UK), he is also working on single-particle cryo-electron microscopy. In August 2018, Martin Trebbin joined the University at Buffalo to continue his work on ultrafast time-resolved structure determination.

Trebbin's leadership in these research areas is recognized by the scientific community and reflected in a large number of international invited seminars. During his research career, he has also already trained a number of young researchers (at BSc/MSc, PhD and PostDoc level) in chemistry, physics, microfluidics, fluid dynamics and structure determination methods. Furthermore, Trebbin has successfully applied for several third party-funded grants (DFG/BMBF/University, as PI or Co-I), as well as peer-reviewed X-ray beamtimes, with which he has laid the groundwork for his research program by developing microfluidic technology for X-ray compatible rapid mixing microfluidics and coupling it to time-resolved structure determination methods.

B. Positions and Honors

Positions and Employment

10/2014 - 08/2018 Assistant Professor ("Ultrafast Structure Determination in Liquids"), Centre for Ultrafast Imaging (CUI), Department of Physics, University of Hamburg, Hamburg, Germany

08/2018 - Assistant Professor & Empire Innovation Professor, Department of Chemistry, BioXFEL Center, Research and Education in eNergy, Environment and Water (RENEW) Institute, SUNY at Buffalo, Buffalo, NY

Other Experience and Professional Memberships

Since 2005- Member of German Chemical Society (GDCh)

Since 2015 Reviewer for different journals: Elsevier (Polymer, Colloids and Surfaces B), RSC (Lab Chip), IUCr (Journal of Synchrotron Radiation) and referee for PETRA III beamtime proposals.

2018 Editorial Board Member, Conceptual Design Report (CDR) for PETRA IV at the German Electron Synchrotron (DESY)

Honors

Since 2014 Multiple international invited talks: USA (SLAC/LCLS, ASU), Germany (e.g. EuXFEL, Max Planck Society), Switzerland (ETH Zürich), Australia, Sweden, Norway, Portugal.

Winter 15/16 1st place University of Hamburg, Department of Physics, teaching prize for "Microfluidics I" in category "Specialized Lecture"

Summer 16 3rd place University of Hamburg, Department of Physics, teaching prize for "Microfluidics" in category "Specialized Lecture"

C. Contributions to Science (in chronological order, Google Scholar: 328 citations, h-index: 10)

1. Rosenberg, M.L, Aasheim, J.H.F, **Trebbin, M.**, Uggerud, E., Hansen, T. Synthesis of a 1,3,4,5-tetrahydrobenzindole β-ketoester. *Tetrahedron Lett.* **50**(47), 6506-6508 (2009).
2. Thiele, J., Windbergs, M., Abate, A.R., **Trebbin, M.**, Shum, H.-C., Förster, S., Weitz, D.A. Early development drug formulation on a chip: fabrication of nanoparticles using a microfluidic spray dryer. *Lab Chip* **11**, 2362 (2011).
3. Schlicke, H., Schröder, J.H., **Trebbin, M.**, Petrov, A., Ijeh, M., Weller, H., Vossmeyer, T. Freestanding films of crosslinked gold nanoparticles prepared via layer-by-layer spin-coating. *Nanotechnology* **22**(30), 305303 (2011).
4. Hanske, C., Erath, J., Kühr, C., **Trebbin, M.**, Schneider, C., Wittemann, A., Fery, A. Adsorption of Spherical Polyelectrolyte Brushes: from Interactions to Surface Patterning. *Zeitschrift f. Phys. Chem.* **226**(7-8), 569-584 (2012).
5. Pillai, S.K.T., Kretschmer, W.P., **Trebbin, M.**, Förster, S., Kempe, R. Tailored nanostructuring of end-group-functionalized high-density polyethylene synthesized by an efficient catalytic version of Ziegler's 'Aufbaureaktion'. *Chem. Eur. J.* **18**, 13974 (2012).
6. Pillai, S.K.T., Kretschmer, W.P., Denner, C., Motz, G., Hund, M., Fery, A., **Trebbin, M.**, Förster, S., Kempe, R. SiCN nanofibers with a diameter below 100 nm synthesized via concerted block copolymer formation, microphase separation, and crosslinking. *Small* **9**, 984 (2012).
7. Taheri, S.M., Fischer, S., **Trebbin, M.**, With, S., Schröder, J.H., Perlich, J., Roth, S.V., Förster, S. Lyotropic phase behavior of polymer-coated iron oxide nanoparticles. *Soft Matter* **8**, 12124 (2012).
8. **Trebbin, M.**, Steinhauser, D., Perlich, J., Buffet, A., Roth, S.V., Zimmermann, W., Thiele, J. & Förster, S. Anisotropic particles align perpendicular to the flow direction in narrow microchannels. *Proc. Natl. Acad. Sci*. U.S.A. **110**, 6706 (2013).

9. Benecke, G., Wagermaier, W., Li, C., Schwartzkopf, M., Flucke, G., Hoerth, R., Zizak, I., Burghammer, M., Metwalli, E., Müller-Buschbaum, P., **Trebbin, M.**, Förster, S., Paris, O., Roth, S.V., Fratzl, P. A customizable software for fast reduction and analysis of large X-ray scattering data sets: applications of the new DPDAK package to small-angle X-ray scattering and grazing-incidence small-angle X-ray scattering. *J. Appl. Cryst.* **47**, 1797 (2014).
10. **Trebbin, M.**, Krüger, K., DePonte, D., Schulz, J., Roth, S.V., Chapman, H.N., Förster, S. Microfluidic liquid jet system with compatibility for atmospheric and high-vacuum conditions. *Lab Chip* **10**, 1733 (2014).
11. With, S., **Trebbin, M.**, Bartz, C.B.A., Neuber, C., Dulle, M., Yu, S., Roth, S.V., Schmidt, H.-W., Förster, S. Fast Diffusion-Limited Lyotropic Phase Transitions Studied in Situ Using Continuous Flow Microfluidics/Microfocus-SAXS. *Langmuir* **30**(42), 12494 (2014).
12. Hermida-Merino, D., **Trebbin, M.**, Förster, S., Rodriguez-Llansola, F., Portale, G. Microfluidic Assisted Self-Assembly of pH-Sensitive Low-Molecular Weight Hydrogelators Close to the Minimum Gelation Concentration. *Macromolecular Symposia*. **358** (1), 59-66 (2015).
13. Khajuria, D.K., Vasireddi, R., **Trebbin, M.**, Karasik, D., Razdan, R. Novel therapeutic intervention for osteoporosis prepared with strontium hydroxyapatite and zoledronic acid: In vitro and pharmacodynamic evaluation. *Mat. Sci. and Eng. C* **71**, 698-708 (2016).
14. Hofmann, E., Krüger, K., Haynl, C., Scheibel, T., Trebbin, M., Förster, S. Microfluidic nozzle device for ultrafine fiber solution blow spinning with precise diameter control. *Lab Chip* **18**, 2225 (2018).
15. Schlenk, M., Drechsler, M. Karg, M., Zimmermann, W., Trebbin, M., Förster, S. Splitting and separation of colloidal streams in sinusoidal microchannels. *Accepted at Lab Chip* (2018).
16. Wiedorn, M., et al. …, Trebbin, M., …, Chapman, H.N., Barty, A. Megahertz serial crystallography. *Accepted at Nature Communications* (2018).

Publications in preparation (working titles)

1. Monteiro, D., Vakili, M., Harich, J., Horrell, S., Inokentijs, J., Meier, S., **Trebbin, M.** X-ray compatible microfluidic flow-focusing Kapton-metal device for fast collection of serial synchrotron crystallography data. *Under review at Lab Chip*.
2. **Trebbin, M.**, With, S., Mark, A., Hanske, C., Wagner, K., Thiele, J., Buffet, A., Perlich, J., Santoro, G., Yu, S., Roth, S.V., Fery, A., Zimmermann, W., Förster, S. Microfluidic SAXS for the high-throughput screening and correlation of complex fluid behavior with structural information. *To be submitted at Lab Chip.*
3. Monteiro, D.C.F, Kopf, F., Fuchs, R., **Trebbin, M.** Rapid mixing liquid jet devices for time-resolved serial femtosecond crystallography on the sub-millisecond scale. *Finalizing manuscript for submission.*
4. Vasireddi, R., Kruse, J., Vakili, M., Kulkarni, S., Keller, T., Monteiro, D.C.F., **Trebbin, M.** GDVN microfluidic nozzle for the spinning of polymer nanofibers, fibres with tunable surface morphologies and nanocomposite fibers. *Finalizing manuscript for submission.*
5. Thiele, C., Monteiro, D.C.F., Schroer, C., **Trebbin, M.** Dynamic flow alignment of anisotropic particles in liquids studied by in situ SAXS tomography. *In preparation*.
6. Vakili, M., Glier, T., Gerling, T., Harich, J., Monteiro, D.C.F., **Trebbin, M.** Polymerization-induced self-assembly of block copolymers in microfluidic channels. *In preparation*.
7. Vakili, M., Gerling, T., Merkens, S., **Trebbin, M.** Kapton-based microfluidic devices with three-dimensional flow-focusing for X-ray scattering. *In preparation*.
8. Monteiro, D.C.F., Creon, A., Harich, J., **Trebbin, M.** Cyclic olefin copolymer with deep microchannels and three-dimensional flow focusing for X-ray scattering. *In preparation*.

Relevant Presentations (selection, last 5 years)

1. Invited talk. **Trebbin, M.** et. al**.** Investigation of Time-Resolved Dynamics Using Rapid Mixing Microfluidics. University of Münster, Germany. (2018)
2. Invited talk. **Trebbin, M.** et. al**.** Investigation of Time-resolved Structural Dynamics Using Rapid Mixing Microfluidics. University of Düsseldorf, Germany. (2018)
3. *Invited talk/contribution.* **Trebbin, M.** et. al**.** Understanding structure-function relationship of proteins via rapid mixing. LCLS-II-HE "First Experiments" meeting, SLAC, Stanford, USA (2017).
4. *Invited talk.* **Trebbin, M.** et. al**.** Rapid Mixing Microfluidics for Time- Resolved X-ray Scattering: from Nanostructures to Structural Biology. Nanotechnology meets Bioengineering Workshop (Fudan-, Macquarie- and Hamburg University), Macquarie University, Sydney, Australia (2017).
5. *Invited talk.* **Trebbin, M.** et. al**.** Rapid Mixing Microfluidics for Time-Resolved X-ray Scattering. Microfluidics Workshop at European XFEL, Schenefeld, Germany (2017).

6. *Invited talk.* **Trebbin, M.** et. al**.** Time-Resolved Structural Biology via Rapid Mixing Microfluidics. Protein Science Days 2017, Lund University, Lund, Sweden (2017).
7. *Invited talk* **Trebbin, M.** et al. Rapid Mixing and Microfluidic Sample Environments for XFELs. Oslo Nordic Workshop on Soft and Biological Matter, Department of Chemistry, University of Oslo, Norway (2017).
8. *Invited talk.* **Trebbin, M.** et al. Microfluidics at High Intensity X-Ray Sources - Latest Results. XFEL/DESY User's Meeting 2017, Photon Science Satellite Meeting: "SAXS/WAXS/GISAXS-User Workshop at DESY", DESY Hamburg, Germany (2017).
9. *Invited talk.* **Trebbin, M.** et al. Time-Resolved Structural Investigations using Microfluidics at High- Intensity X-ray Sources: from Nanostructures to Structural Biology. Department of Multifunctional Materials, ETH Zürich, Switzerland (2016).
10. *Invited talk.* **Trebbin, M.** et al. Time-Resolved Structural Investigations using Microfluidics at High- Intensity X-ray Sources: from Nanostructures to Structural Biology. Workshop on triggering time-resolved reactions "Light. Mixing. Action!", EU-Action CM1306 Workshop, Porto, Portugal (2016).
11. *Invited talk.* **Trebbin, M.** et al. Rapid Mixing and Microfluidic Sample Environments for XFELs. Single Particle Injection Technology workshop with a focus on samples & injection. Laboratory of Molecular Biophysics, Uppsala University, Sweden (2016).
12. *Invited talk.* **Trebbin, M.** et al. Microfluidic Tools for Time-Resolved Structural Biology. LCLS-II-Workshop "Scientific Opportunities for Ultrafast Hard X-rays at High Repetition Rate: An Energy Upgrade of LCLS-II", SLAC, Stanford, USA (2016).
13. *Invited talk.* **Trebbin, M.** et al. Considerations for time-resolved rapid mixing experiments at XFELs. 3rd Ringberg Meeting on Structural Biology with FELs (by invitation only), Max Planck Society, Ringberg Castle, Tegernsee, Bavaria, Germany (2016).
14. *Talk.* **Trebbin, M.** et al. Microfluidics at Microfocus X-ray Sources: Status and Perspectives. XFEL/DESY User's Meeting 2016, Photon Science Satellite Meeting: "SAXS/WAXS/GISAXS-User Workshop at DESY", DESY Hamburg, Germany (2016).
15. *Talk.* **Trebbin, M.** et al. Microfluidics at high-intensity X-ray sources. SRPS6, 6th International Conference on Synchrotron Radiation in Polymer Science, Madrid, Spain (2015).
16. *Invited attendance.* 2nd Ringberg Meeting on Structural Biology with FELs (by invitation only), Max Planck Society, Ringberg Castle, Tegernsee, Bavaria, Germany (2015).
17. *Talk.* **Trebbin, M.** et al. X-rays and Microfluidics: Current and Future Developments. XFEL/DESY User's Meeting 2015, Photon Science Satellite Meeting: "SAXS/WAXS/GISAXS-User Workshop at DESY", DESY Hamburg, Germany (2015).
18. *Invited talk.* **Trebbin, M.** et al. Microfluidics at High-Intensity X-ray Sources. LCLS/SLAC User's Meeting 2014, SLAC, Stanford, USA (2014).
19. *Talk.* **Trebbin, M.** et al. Anisotropic particles align perpendicular to the flow direction in narrow microchannels. 34th Dynamics Days Europe, University of Bayreuth, Germany (2014).
20. *Invited talk*. **Trebbin, M.** et al. Microfluidic Sample Environment Platform. 2nd PSCM Workshop on "Enhanced User Support and Partnership Projects for Soft Matter Science", ESRF/ILL, Grenoble, France (2014).
21. *Talk.* **Trebbin, M.** et al. Microfluidic Liquid Jet System with compatibility for atmospheric and high-vacuum conditions. FLOW14, 1st International Conference on Micro & Nanofluidics Fundamentals and Applications, University of Twente, Enschede, The Netherlands (2014).
22. *Talk.* **Trebbin, M.** et al. Microfluidics at high-intensity X-ray sources: from microflow chips to microfluidic liquid jet systems. 22nd International Congress on X-ray Optics and Microanalysis (ICXOM), University of Hamburg, Germany (2013).
23. *Invited talk.* **Trebbin, M.** et al. Versatile Microfluidics: on microfocus SAXS, perpendicular colloid alignment and liquid jets Invited talk. Laboratoire Interdisciplinaire de Physique, Université Joseph Fourier, Grenoble, France (2013).
24. *Talk.* **Trebbin, M.** et al. Microfluidics at P03/MiNaXS: The latest results. HASYLAB User's Meeting 2013 - Satellite Meeting: Status and Perspectives of Small Angle X-ray Scattering at DESY, DESY Hamburg, Germany (2013).
25. *Invited talk.* **Trebbin, M.** et al. Microfluidic liquid jet systems. XFEL User's Meeting 2013 - Satellite Meeting: Challenges for sample delivery at the European XFEL Facility, DESY Hamburg, Germany (2013).

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

DFG (15 PhD, 2 PDRA) Santra, Pearson (PI) pre-proposal accepted
International Training Network: Frontiers in Structural Dynamics: from Materials Science to Biology (with Arizona State University as partner)
The goal of this study is to establish a training network on experimental and theoretical topics related to ultrafast structure determination in matter.
Role: Co-I

BBSRC (1yr PDRA) Muench (PI) 07/2017-06/2018
Time-resolved methodologies to provide both spatial and temporal resolution in Electron Microscopy (with Astbury Centre for Structural Molecular Biology (ACSMB), University of Leeds)
The goal of this study is to develop spray devices for cryo-EM sample preparation (V-ATPase).
Role: Co-I

BMBF (2 M€) Pearson (PI) 07/2016-06/2019
HATRX-SFX: Hadamard-Kristallographie als Methode zur zeitaufgelösten Untersuchung der Strukturdynamik von Biomolekülen
The goal of this study is to establish time-resolved serial synchrotron crystallography (SSX) at beamlines P14.2 (endstation construction/commissioning is part of the proposal) and P11 at PETRA III (DESY, Hamburg).
Role: Co-I

Completed Research Support

PIER (50 k€) Trebbin (PI) 04/2017-02/2018
Controlled nano- and micro-droplet generation using microfluidic liquid jet devices (PI)
The goal of this study was to create microfluidic sample environment for X-ray free electron sample delivery.
Role: PI
Manuscripts *in preparation*:
Vasireddi, R., Monteiro, D.C.F., Raju, S., Kopf, F., Nette, J., Trebbin, M. Fluid dynamics of microfluidic gas-focused flat liquid sheets.
Valerio, J., Vasireddi, R., Vakili, M., Lehmkühler, F., **Trebbin, M.**, Grübel, G. Nano-rheology: flow orientation in gas-focused liquid jets.

PIER (33 k€) Ramirez (PI) 04/2016-10/2017
Mechanistic studies on cation exchange reactions in nano-crystals via in-situ optical and synchrotron X-ray structural characterization
The goal of this study is to create an X-ray and UV-VIS compatible microfluidic sample environment (compatible for high temperatures and organic solvents) to investigate nanocrystals in situ.
Role: Co-I
Manuscript *in preparation*: Palenzia Ramirez, C., Seher, R., Vakili, M., Bommel, S., Krohn, J., Lehmkühler, F., **Trebbin, M.**, Grübel, G., Weller, H. Nucleation and growth of CdSe-nanoparticle studied *in situ* with SAXS, WAXS and UV/VIS.

Awarded Large Facility Access

Since 2014: 21 granted multi-day beamtimes (BT) at **EuXFEL** (3x BT), **APS** (1x Long-term project (LTP)), **ESRF** (5x BT, 1x Block Allocation Group (BAG)), **Diamond** (1x BAG), **PETRA III** (7x BT, 2x LTP, 1x BAG) (and many additional beamtimes granted during PhD-time at U Bayreuth).