***PhD Researcher Position:***

*Walther Lab @ University of Mainz – Germany (www.walther-group.com)*

# 3D Printed Synthetic Cells for Chemical Communication

**Key words: Artificial Cells, Synthetic Cells, Chemo-Mechanical Feedback, pH Feedback Systems, pH Waves, Polymer Chemistry, Responsive Hydrogels, Two-Photon Lithography, 3D Printing, Systems Chemistry**

## Project Description:

Building on our pioneering work on pH-feedback systems and homeostatic synthetic cells (see references below), we want to open a new route to synthetic cells and to their spatial organization: high-resolution 3D printing to enable placement with µm precision into controlled landscapes and tissues. The scientific core of the project is to engineer chemical communication by pH waves to reach sustained oscillations and collective behavior across synthetic cell consortia. Your tasks are roughly centered around:

- Development of enzyme-compatible, pH-responsive hydrogel resins for two-photon lithography
- 3D printing of syncell units, design of spatial landscapes and 3D tissues
- Integration of pH-feedback systems (e.g. urease, glucose oxidase, enzymatic cascades)
- Investigation of communication between syncells via pH waves, and of collective phenomena such as synchronization in syncell consortia

The project unites systems chemistry, advanced microfabrication and quantitative microscopy. It also offers the chance to develop simulation approaches for reaction–diffusion processes to rationalize and predict the behavior. You will be embedded in our team, which holds dedicated in-house expertise in 3D printing, pH-feedback systems and modeling, and you will have assistance on the various aspects of the topic to quickly gain ground.

For excellent candidates, we will pursue an association to the Max Planck Graduate Center to provide you with the widest interdisciplinary networking and career-development opportunities.

**We offer:**

- a collaborative and interdisciplinary research team with a dedicated mission of making materials and molecular systems intelligent
- a highly engaging and current research topic in excellently equipped lab infrastructures; including a state-of-the-art 3D printer and all analytical facilities needed for your research
- an inspiring environment with international and ambitious teams
- ample opportunities to develop beyond your core project
- a stimulating local research environment with excellent collaboration possibilities
- support for personal development with attendance to conferences, workshops and soft skill seminars
- excellent and close support of PhD researchers
- possibilities for national and international collaboration

**Walther Lab.** The Walther Lab at JGU Mainz is one of the pioneers in the field of life-like materials and systems at the interface of systems chemistry/chemical reaction networks, DNA nanoscience, polymer materials, and the interface to cells. We are excited to empower systems, materials, and synthetic cells with embodied intelligence – chemical and physical – to endow them with the capacity to compute, adapt, learn, or make simple decisions. We are highly international and interdisciplinary, and act as a team to solve complex challenges. Prof. Andreas Walther has received three ERC grants (Starting, Consolidator and Advanced Grant), is a Max Planck Fellow, and a founder of one DFG Cluster of Excellence (> 270 publications in high impact journals, h-index > 80).

**FURTHER READING:**

1. J. Krehan, C.-R. Li, M. Masukawa, E. Amstad, A. Walther* “Homeostatic Artificial Cells Enable Self-Protection in Prototissue Spheroids” **Chem** 11, 102409 (2025).
2. Feature Article. C. Sharma, I. Maity, A. Walther “pH Feedback Systems to Program Autonomous Self-Assembly and Material Lifecycles” **Chem. Commun.** 59, 1125 (2023).

3. I. Maity, C. Sharma, F. Lossada, A. Walther “Feedback and Communication in Active Hydrogel Spheres with pH Fronts: Facile Approaches to Grow Soft Hydrogel Structures” **Angew. Chem. Int. Ed.** 60, 22537 (2021).
4. X. Fan, A. Walther “Autonomous Transient pH Flips Shaped by Layered Compartmentalization of Antagonistic Enzymatic Reactions” **Angew. Chem. Int. Ed.** 60, 3619 (2021).
5. X. Fan, A. Walther “pH Feedback Lifecycles Programmed by Enzymatic Logic Gates Using Common Foods as Fuels” **Angew. Chem. Int. Ed.** 60, 11398 (2021).
6. C. Sharma, A. Walther “Self-Regulating Colloidal Co-Assemblies That Accelerate Their Own Destruction via Chemo-Structural Feedback” **Angew. Chem. Int. Ed.** 61, e202201573 (2022).
7. B. Dúzs*, O. Skarsetz, G. Fusi, C. Lupfer, A. Walther* “Mechano-adaptive Meta-Gels through Synergistic Chemical and Physical Information-Processing” **Nat. Commun.** 15, 8957 (2024).
8. G. Fusi, D. Del Giudice, O. Skarsetz, S. Di Stefano, A. Walther “Autonomous Soft Robots Empowered by Chemical Reaction Networks” **Adv. Mater.** 35, 2209870 (2023).
9. Viewpoint Article. A. Walther “From Responsive to Adaptive and Interactive Materials and Materials Systems: A Roadmap” **Adv. Mater.** 32, 1905111 (2020).

**EXPECTED CANDIDATE PROFILE**

- highly motivated candidate with a very good degree in Chemistry, Chemical Engineering, Polymer Science, or Materials Science.
- Interest in microfabrication and 3D printing; prior experience with hydrogels, enzymes, polymer synthesis or microscopy is a plus
- Independent and self-responsible work ethic
- Enthusiasm for basic research, creative experimental approaches, and scientific networking
- Excellent English skills and enjoyment of teamwork

Please send your full application as a **single** PDF file with the subject “3D-Printed Synthetic Cells” containing

- Letter of motivation including a summary of your past research experience and research interests
- A meaningful summary of your Master thesis
- Transcript of records of your Master and Bachelor program.
- Curriculum vitae and list of publications
- One, or if possible, two contacts for reference letters

to Walther-applications@uni-mainz.de

We look forward to receiving your application!

**The position is according to the German salary scale (TVL 13 65%) with full social benefits.**

The position is available from 1 October 2026 onwards (start date flexible) and applications will be evaluated on a rolling basis until the position is filled. Deadline for applications is September 30th 2026.