PhD Researcher Position:

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

Max Planck Graduate Center between MPI for Polymer Research and JGU

Novel Polymer Mechanochemistry using Combinations of Metamaterials and Chemical Reaction Networks

Key words: intelligent matter, polymer mechanochemistry, hydrogels, systems chemistry, 3D printing

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 artificial 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 two ERC grants, is a Max Planck Fellow, and a founder of one DFG Cluster of Excellence (> 270 publications in high impact journals, h-index 80).

Project Description:

Building on our pioneering work on pH feedback mechanisms mediated by enzymatic reaction networks and hydrogel-based mechanical metamaterials (see references below), we plan to develop a new type of mechanochemistry that allows geometrical changes of a material (e.g. bending, twisting, compaction) to be translated into defined chemical states, that themselves can feed back into the material configuration. Your tasks are roughly centered around:

- Formulation of multistable enzymatic reaction networks and their incorporation into hydrogels
- Synthesis and fabrication of hydrogels, hydrogel beads, and hydrogel metamaterials
- Analysis of the chemo-mechanical and decision-making behavior on a materials system level

Next to real-life materials, the project also offers the chance to develop simulation approaches (e.g. using COMSOL Multiphysics) to rationalize and predict systems in the computer. You will be embedded in our team and will have assistance on the various aspects of the topic to quickly gain ground in the various aspects.

For excellent candidates, we will pursue an association to the Max Planck Graduate Center between the Max Planck Institutes and JGU Mainz 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 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

FURTHER READING:

1. 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).
2. J. Krehan, C.-R. Li, M. Masukawa, E. Amstad, A. Walther* "Homeostatic Artificial Cells Enable Self-Protection in Prototissue Spheroids" **Chem**, 102409 (2025).
3. G. Fusi, D. Del Giudice, O. Skarsetz, S. DiStefano, A. Walther "Autonomous Soft Robots Empowered by Chemical Reaction Networks" **Adv. Mater.** 35, 2209870 (2022).
4. O. Skarsetz, V. Slesarenko, A. Walther "Programmable Auxeticity in Hydrogel Metamaterials via Shape-Morphing Unit Cells", **Adv. Sci.** 2201867 (2022).
5. O. Skarsetz, P. J. M. Swinkels, J. Figueiredo da Silva, G. Vozzolo, M. Masukawa, G. Fusi, B. Duzs, Y. Lassiat, C. Drees, V. Slesarenko, A. Walther "Soft Robotic Engines with Non-Reciprocal Motion by Physical Intelligence" **Adv. Mater.** e11630 (2025)
6. Feature Article. C. Sharma, I. Maity, A. Walther "pH Feedback Systems to Program Autonomous Self-Assembly and Material Lifecycles" **Chem. Commun.** 59, 1125 (2022).
7. Viewpoint Article. A. Walther "From Responsive to Adaptive and Interactive Materials and Materials Systems: A Roadmap" **Adv. Mater.** 1905111 (2020)

EXPECTED CANDIDATE PROFILE

- highly motivated candidate with a very good degree in Chemistry or Chemical Engineering.
- 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 "Chem-Mechano-Materials"** 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 both andreas.walther@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 July 2026 and applications will be evaluated on a rolling basis until the position is filled. Deadline is End of May 2026.