PhD Researcher Position

Photochemical Regulation of Chemical Reaction Networks for the Design of Adaptive Life-Like Supramolecular Systems

Key words: Photochemistry, Chemical Reaction Networks, Supramolecular Chemistry, Systems Chemistry, Microscopy

BACKGROUND AND SCOPE

Signaling networks in cells provide biochemical intelligence to cellular systems and allow them to operate autonomously. Similarly, de novo designed artificial chemical reaction networks (CRNs) can provide chemical intelligence and autonomous behavior to synthetic molecular systems – most notably they can provide transient self-assembly states or allow for simple computations. The Walther Lab has pioneered such CRNs for making transient self-assemblies of block copolymers, peptides and DNA, and has pushed this also to the materials level. In this project, we want to take the next critical step and implement light-adaptive behavior into such CRNs so that different colors of light can modulate their behavior and cross-regulate the properties in a molecular system. The scope of this project is to engineer photoswitches, photochemical reactions, and photoprotected molecules that interact with such a CRN and then transfer this understanding to the spatiotemporal regulation of transient self-assemblies and later even materials. The project thus bridges from molecular design using organic chemistry to the study of photophysical properties, to their influence on CRNs, and, finally, to understand complex self-assembling molecular systems.

Team. We are an ambitious team, and this position is embedded in an ERC Consolidator Grant project! We provide you with an inspiring and collaborative team atmosphere in a multinational and multidisciplinary environment, and ample opportunities to develop. Brand new, cutting-edge synthetic and analytical infrastructure and facilities are available due to generous support by the University of Mainz and the Gutenberg Research College. Prof. Walther (h-index 62, age 42) is a Gutenberg Research Professor, a Max Planck Fellow and a 2 x ERC Awardee. More information on the group can be found here: www.walther-group.com

EXPECTED CANDIDATE PROFILE

As an ideal candidate you are creative, highly self-motivated, ambitious, and communicative to excel in scientific challenges. You hold a M.Sc. in Chemistry and have a background in physical organic chemistry, photoswitches or supramolecular chemistry, and your performance in your M.Sc. should be clearly above average. Additional qualifications in microscopy, polymer materials, DNA Nanoscience or Python/Matlab programming is a plus. We are willing to train you in complementary skills.

Selected references on related topics in the past:

1. **Review:** "Materials Learning from Life: Concepts for Active, Adaptive and Autonomous Molecular Systems" *Chem. Soc. Rev*. 46, 5588 **(2017)**.
2. **Viewpoint:** "From Responsive to Adaptive and Interactive Materials and Materials Systems: A Roadmap" *Adv. Mater.* 1905111 **(2020)**
3. **Review:** "ATP-Responsive and ATP-Fueled Self-Assembling Systems and Materials" *Adv. Mater.* 32, 2002629 (**2020**).
4. „Self-Regulating Colloidal Co-Assemblies That Accelerate Their Own Destruction via Chemo-Structural Feedback" *Angew. Chem. Int. Ed.* **2022,** *61*, e202201573 **(2022)**.
5. "Wavelength-Gated Adaptation of Hydrogel Properties via Photo-Dynamic Multivalency in Associative Star Polymers" *Angew. Chem. Int. Ed.* 60, 4358 (**2021**).
6. "ATP-Powered Molecular Recognition to Engineer Transient Multivalency and Self-Sorting 4D Hierarchical Systems" *Nat. Commun.* 11, 3658 (**2020**).
7. "Spinodal Decomposition of Chemically Fueled Polymer Solutions" *Soft Matter* 15, 5401, **(2021).**
8. "Multiple Light Control Mechanisms in ATP-fueled Non-Equilibrium DNA Systems" *Angew. Chem. Int. Ed.* 59, 12084 **(2020)**.
9. "Chemically Fueled Volume Phase Transition of Polyacid Microgels" *Angew. Chem. Int. Ed*. 133, 60, 7117 (**2021**).
10. "Biocatalytic Feedback-Driven Temporal Programming of Self-Regulating Peptide Hydrogels" *Angew. Chem. Int. Ed*, 54, 13258 **(2015)**.

The position is available from February/March 2023 and has a duration of 3 years.
Application Deadline is January 10th 2023.

Please send your full application as a **single** PDF file containing

- letter of motivation including a summary of your past research experience, in particular a meaningful summary of your master thesis; transcript of records of your Master and B.Sc. program.
- Detail in your letter why you believe you are the right person and what you expect from us
- curriculum vitae and list of publications (if applicable)
- Two contacts for reference letters

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