

GRK 2516 Soft Matter Seminar

Dec. 18, 2020 at 10:30 a.m.
via Zoom

Research seminar of the DFG Research Training Group GRK 2516 (<https://grk2516.uni-mainz.de>).

Thomas Hermans
University of Strasbourg, CNRS

Dissipative Supramolecular Systems and Materials

Looking at nature, we see that living materials with biological functionality, such as the actin or microtubule (MT) cytoskeletal network, achieve dynamics as well as supramolecular structures with the same protein building blocks. In other words, the components can assemble, but also react (i.e., tubulin is also an enzyme that hydrolyses guanosine triphosphate GTP), which in turn affects the assemblies. In this way, living systems use chemical fuels (e.g., GTP) and self-assembly to create a built-in chemomechanical interaction. Moreover, such networks operate in sustained out-of-equilibrium states at the onset of oscillations,^{1–3} which results in rapid response and adaptivity. Here, we present our recent^{4–6} reaction cycles in solution and gels, where interesting new behaviors were found, such as supramolecular size oscillations, traveling polymerization, or transient disassembly. We hope such reaction cycles form the basis of new life-like materials where material properties are fuel (and waste) dependent.

1. Obermann, H., Mandelkow, E. M., Lange, G. & Mandelkow, E. Microtubule oscillations. Role of nucleation and microtubule number concentration. *J. Biol. Chem.* 265, 4382–4388 (1990).
2. Valiron, O., Caudron, N. & Job, D. Microtubule dynamics. *Cell. Mol. Life Sci. CMLS* 58, 2069–2084 (2001).
3. Westendorf, C. et al. Actin cytoskeleton of chemotactic amoebae operates close to the onset of oscillations. *Proc. Natl. Acad. Sci.* 110, 3853–3858 (2013).
4. Singh, N., Lainer, B., Formon, G. J. M., De Piccoli, S. & Hermans, T. M. Reprogramming Hydrogel Properties Using a Fuel-Driven Reaction Cycle. *J. Am. Chem. Soc.* 142, 4083–4087 (2020).
5. Leira-Iglesias, J., Tassoni, A., Adachi, T., Stich, M. & Hermans, T. M. Oscillations, travelling fronts and patterns in a supramolecular system. *Nat.*

Nanotechnol. 13, 1021 (2018).
6. Unpublished. (2020).

Contact:
cosarins@uni-mainz.de

